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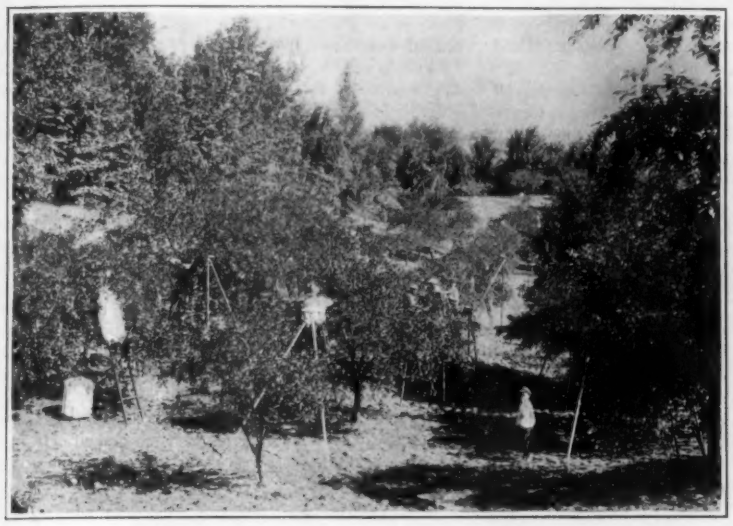


Cherry-picking time in a cherry-growing district

Cherry-pickers and the special ladders they use

Utilization of Cherry Waste Products*

By Frank Rabak

THE fruit-packing industry of the United States has developed rapidly in recent years. This rapid development has been accompanied by large accumulations of by-products which have no apparent value, and hence are discarded as waste. These waste products may occur as either the exterior or the interior portion of the fruit, and in some instances even the fruit itself being unsuitable for packing becomes a waste material.

Attention has recently been called to the large quantities of waste resulting in the extensive cherry-packing industry of the North Atlantic, North Central and Western States. In the canning of cherries, large quantities of pits and juice result from the pitting process to which the fruit is subjected. At the present time these by-products are entirely wasted because of their lack of utilization.

The extent of the cherry-packing industry is indicated in the agricultural statistics of the States mentioned. According to the thirteenth census of the United States, the quantity of cherries grown in New York in 1909 was 271,597 bushels, in Michigan 338,945 bushels, and in Wisconsin 81,340 bushels, making a total of 691,882 bushels, or 20,756 tons. The amount grown at the present time is doubtless considerably in excess of these figures. Approximately 80 per cent of the crop is canned, which is equivalent to 553,506 bushels, or 16,605 tons. The total output of the California orchards in 1909 was 501,013 bushels, or about 15,000 tons.

The two by-products of the cherry industry, the pits and the juice, are at present entirely wasted. From the standpoint of commercial utilization the pits, which constitute about 15 per cent of the cherries, are the largest and most important of these waste products.

During the year 1914, it was estimated that 1,600 tons of pits were available as a by-product. This tonnage of waste pits is, of course, dependent largely upon the crop of each season with an increasing tendency as the industry expands.

The cherry juice which results simultaneously with the pits accumulates to a somewhat less extent. It is estimated that about 70 gallons of juice result from one ton of cherries. The approximate quantity of juice available annually as a waste product is about 112,000 gallons.

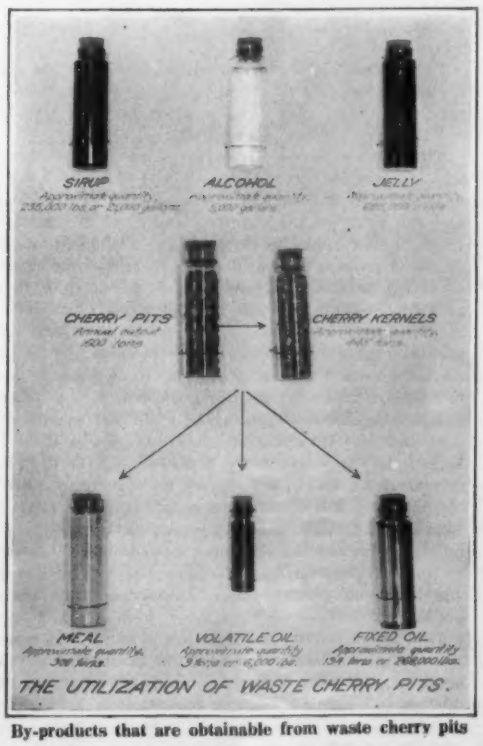
Much thought and consideration has been given by packers to the possible utilization of these waste products which if converted into marketable substances would give added stimulus to this important branch of the fruit industry.

It has been found by investigation that a fatty oil not greatly dissimilar to that of sweet almonds, peach, or apricot kernels, can be extracted from the waste pits. The oil is contained in the kernels, which by the application of hydraulic pressure can be made to yield about 30 per cent of fatty oil. Besides, the fatty oil there can be produced a volatile oil which is for all practical purposes identical to the oil of bitter almonds. The cherry kernel meal remaining possesses valuable stock-feeding qualities.

Cherry juice has been found capable of being converted into alcohol, sirup or jelly.

In outlining a process for the utilization of the pits, the initial step consists in the separation of the kernels from the pits by cracking and subsequent screening. The resulting kernels when reduced to a meal by grinding and subjected to hydraulic pressure can be made to yield the fatty oil previously mentioned. The press cake remaining from this procedure when macerated with water and distilled with steam yields the volatile oil, the cherry kernel meal remaining as a residue.

Cherry kernel oil possesses a pale golden yellow color, and a bland odor with a fatty, nutlike taste. A careful examination of the physical and chemical properties of the oil has shown that although it is not identical with almond, peach, or apricot kernel oil, it is not fundamentally different from any of these. Since almond, peach and apricot kernels yield oils of commercial value, cherry kernel oil, which stands in close relationship, should likewise be commercially useful. Almond oil is at present used chiefly in pharmaceutical preparations. Peach and apricot kernel oils besides their use as edible oils are also therapeutically efficient.



By-products that are obtainable from waste cherry pits

Cherry kernel oil should be adapted to all the purposes for which these oils are at present used.

Considering 1,600 tons as a normal year's supply of pits which consist of 28 per cent kernels, there would be available annually 448 tons of kernels. From this quantity of kernels 134 tons or 268,000 pounds of fatty oil should be obtainable. The value of the oil would depend entirely upon its particular use and demand. The price of the closely related peach kernel oil ranged from 22 cents a pound in 1913 to 45 cents in 1915.

The volatile oil which does not pre-exist in the kernels but is found by chemical reaction when the ground press cake is macerated in water is obtained to the extent of 0.95 per cent by distillation of the macerated mixture. About one pound of volatile oil may be obtained from 100 pounds of press cake, and is practically identical in both physical and chemical properties to the oil of bitter almonds, peach or apricot kernels. The volatile oil of cherry kernels is a pale straw colored liquid with pleasant characteristic bitter-almondlike odor and a sweet and strongly pungent taste.

Approximately 314 tons of press cake would be available annually for the production of the volatile oil. Calculating on the basis of 0.95 per cent yield, about 3 tons or 6,000 pounds of volatile oil would result. The volatile oil from cherry kernels being closely identified with the bitter-almond oil, which is used medicinally and in the manufacture of perfumery and confectionery, should find similar application in commerce. The wholesale price of bitter almond oil during the year 1915 was $6 per pound. In January, 1916, the oil was virtually unobtainable and was quoted at $9.25 to $11 per pound. It seems reasonable, therefore, that the production of the volatile oil constitutes an important step in the conversion of the waste pits into a source of profit.

The residue remaining after extraction of the volatile oil when dried and reduced to meal is suggested as a stock-food. A comparison of the meal with other standard feeding stuffs places it in a class with linseed and cottonseed meals, both of which are recognized as valuable stock foods, the current prices of which average about $30 per ton. Roughly estimated the total available quantity of meal which would result annually after extraction of fatty oil and volatile oil would be about 300 tons.

The waste cherry juice resulting from the pitting of the fruit is a bright red liquid with the characteristic odor and taste of cherries. Experiments have

(Concluded on page 598)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Germany's Strategic Hold on American Industries

OURS is a wonderful country. Rich in all the natural products that man could desire. So rich that we have been prodigal in the use of materials placed at our disposal. Nevertheless, we have been industrious, and we have manufactured within our own boundaries most of the products we need. For only a very small part of the goods we require has it been necessary for us to look abroad. Our exports are greater than our imports. Before the war we were even sending to Germany a larger bill of chemicals than Germany was sending to us. It was natural for us to consider ourselves industrially independent. Certainly we were not gravely concerned by the fact that some necessary products still came from abroad.

When the war broke out, much to our astonishment, we found ourselves badly crippled for the lack of a few essential products. We realized then, the strategic importance of Germany's coal-tar industries, for by reason of the scarcity of dyes our great textile industries were paralyzed. Our very health was threatened for lack of important drugs which had always come from Germany. Even the food of the nation was affected by the sudden cessation of imports of potash.

It is not to be inferred that we are accusing Germany of having sought to destroy the industrial independence of this country by aiming at its clothing, its food and its health. The potash supplies of Germany are a natural resource. We have quantities of potash in this country, but as yet have not developed an economical method of obtaining it in practical form. As for the coal-tar products, surely no country in the world is in a better position than this to supply all of its own needs and have a large surplus for exportation. Our production of pig iron is twice that of Germany, and consequently our production of coke must be correspondingly as great. But instead of saving the valuable by-products of coke manufacture we have been burning them up in the destructive beehive furnace.

In the past there has been little encouragement for us to save the coal tar, and it is for this reason that we suddenly find our industries dependent upon foreign products. The very consumers of these products have been unwilling to bear the cost of protecting the infant industries against foreign competition.

We ourselves are to blame for the dependent condition of our industries.

The House Shipping Bill

THE Shipping Bill of the year 1916 is the Shipping Bill of 1915 in a new dress. It is wrong in principle and amateurish in scope and construction—wrong in principle, because it places the Government in direct competition with private enterprise; amateurish in scope and construction, because from first to last it shows that its sponsors have not appreciated the magnitude of the problem, and have refused to be guided by the experience and wisdom of the practical shipping men of the country, who alone are versed in the intricate problems which are involved in the shipping business.

Briefly put, the bill creates a United States Shipping Board from which is to be excluded any one who "holds any official relation to any common carrier by water"—which shuts out at once practically all the men who have any experience or expert knowledge of the project.

The Board "may form . . . one or more corporations for the purchase, construction, lease, charter, maintenance and operation of merchant vessels in the commerce of the United States. The total capital stock thereof shall not exceed $50,000,000."

"The Board may, for and on behalf of the United States, subscribe to, purchase, and vote not less than a majority of the capital stock of any such corporation."

Five years after the close of the war the corporation will be dissolved, the vessels will revert to the Board, and the Board may sell the ships and take over the stock not held by the United States at a fair value.

The Board is to exercise a supervision of all carriers by water engaged in the foreign and interstate commerce of the United States, broadly similar to that exercised by the Interstate Commerce Commission over the railroads.

Now we are unalterably opposed to this bill, because the entrance of the United States into the shipping business in competition with private interests would be at once a moral wrong and an economical blunder. Not only would it be an act of gross injustice to the citizens who have hopefully enlisted their capital in the effort to build up an American merchant marine, but, economically considered, the bill would inevitably defeat the very object at which it aims. With their own Government as a competitor, the shipping interests would fail to invest a dollar of capital to carry on a struggle which is already bristling with difficulty and discouragement.

But we object to the bill further upon the ground that the proposed Government Board, with its paltry $50,000,000, would be in a position to do no more than toy with this vast problem.

The National Foreign Trade Council has submitted to Congress a statement of its Merchant Marine Committee which shows that to increase within the next ten years the American foreign commerce carried in American ships from the present level of 14.3 per cent to 60 per cent would require between 6,000,000 and 10,000,000 tons of shipping, and the cost of the ships would be from $520,000,000 to $1,040,000,000.

In the presence of these authentic figures, compiled by the men who know, it will be seen why we have designated the shipping bill as amateurish. The House bill should be rejected as a pernicious makeshift—a mere playing with the problem.

And yet the necessary capital would be forthcoming if the present Administration would forego its foolish desire to embark in business, and settle down to the development of a broad, far-sighted shipping policy, that would encourage the investment of private capital.

And the very first thing it should do is to repeal those iniquitous sections of the Seamen's Act which have already driven some of our most promising shipping enterprises off the seas.

The Dye Industry as a Factor of National Security

THE great European war has been a wonderful school teacher. It has taught us values never appreciated before. It has, above all, demonstrated our inconsistency. We have been so fearful of militarism that we dared not increase the size of our army, lest it attack neighboring countries and involve us in destructive war, and yet we have been content to place entire confidence in the good intentions of powerful foreign countries armed to the very teeth. We have trusted them not to attack our rich treasure land.

Other lessons we have learned. We have discovered that mere numbers of men count for little; that it takes months to make a soldier of a raw recruit; that a fortress is valueless; that without heavy artillery an army is as helpless as the man with a crossbow against a rifleman. We have learned that a modern battle pours forth costly shells like water. To keep the guns in action all the machine shops of a great nation must work night and day.

But probably the most startling lesson of the war is one that has only just begun to dawn upon us, namely, that there is a very close relation between the dye industry and preparedness for war.

There was a period, not many years since, when the dye industry in this country showed signs of healthy development. But at best the quantities of dyes used and the value of the industry compared to others of which it is a necessary adjunct, are so small that the public is not apt to consider seriously the importance of giving it adequate protection. The users of dyestuffs have been only too willing to let the industry languish, and thus it happened that Germany was permitted to undersell the American product and obtain complete control of the situation. Now that the war has thrown us upon our own resources, we have been endeavoring frantically to produce the needed dyes in this country. Raw materials are plentiful. There is no reason why we should not produce all the dyes we need in this country; only a very few are hedged about by patents. But what inducement is there for any company to engage in the production of dyes when, upon the declaration of peace, conditions will revert to the state immediately preceding the war, and there will be no adequate means of competing with foreign products?

Just here is where our latest lesson of the war comes in. We are beginning to realize the advantage to Germany of possessing a practical monopoly of the manufacture of dyestuffs. *A dye factory may be changed within a week or ten days into a factory for the production of high explosives.* The same materials are used and the same processes up to a certain point.

According to recent statistics, we are now, after eighteen months of feverish activity, in a position to produce 33 tons of carbolic acid a day, which is equivalent to about 80 tons of picric acid per day, which in turn is equivalent to about 53,000 shells per day. We recall that in a single day of real fighting the Allies consumed approximately 1,000,000 shells. Were we unequipped with the temporary plants now in service and suddenly confronted by a great war, it would take us 18 months to be in a position to produce 53,000 shells per day. We would have to continue this production for three weeks in order to prepare for a single day of real battle.

It has not occurred to us before to look upon the process of making delicate tints and shades, surely the gentlest of all arts, as one capable of being turned almost over night into a powerful factor of defense. Viewed in this way, is there not every reason why our dye industries should receive the protection they require? It is impracticable to lay by large stores of high explosives. Far better is it to have our ammunition plants kept ever ready for war service by using them in time of peace to manufacture commercial products. If our dye industry were developed to such a point as to produce all the dyestuffs used in this country (estimated at 60,000,000 pounds per year), we would be capable in time of war of producing 100 tons of high explosives, such as picric acid and trinitrotoluol. At an average of three pounds of high explosive per shell, we would be able on a week's notice to produce 67,000 shells per day, which, while not at all sufficient for a battle such as that of the Marne, would at least give us a nucleus of formidable proportions.

The dye industry has suddenly loomed up as a most important element of the national equipment. Its protection and development are of vital importance to the whole country.

Novelistic Science

IT is a paradox that, although science in itself surpasses the most ingenious fiction in sheer romance and in its appeal to man's love of the marvelous, scientific themes are not often successfully used by writers of fiction. In artistic literature science plays a conspicuously small part, considering its immense importance in real life. On the other hand the introduction of ostensibly scientific details has been responsible for a great deal of painfully inartistic literature.

Whatever our grandsires may have thought of Mrs. Shelley's "Frankenstein"—and the tale achieved, at least, such prominence that its title has become a proverb—the idea of assembling fragments of humanity from the tomb and the dissecting-room and patching them together to produce a living being is intolerably grotesque to contemporary readers of fiction. We have a feeling that the *artistic* way to create Frankenstein's monster would be to begin by manufacturing protoplasm in the laboratory and, by suitable manipulation, to make it develop itself into what one willed. Yet Mrs. Shelley's method is not essentially unscientific. Within the past decade we have witnessed remarkable achievements in the transplanting of tissues and organs from one living body to another, and even their maintenance in a state of vitality outside the body, suggesting that, however crude in detail, the story of "Frankenstein" may be prophetic in its central idea.

A plausible modern version of "Frankenstein" might make a thrilling story, but would it be legitimate art? Is it not true that scientific miracles, even when invested with the air of reality that such writers as Jules Verne and H. G. Wells have been able to compass, never vie in artistic appeal either with portrayals of familiar human experiences or with flights of pure fancy that do not try to justify themselves by an appeal to reason?

The idea of a monster developed in the laboratory by manipulating and stimulating a mass of protoplasm is, we believe, more acceptable from an æsthetic point of view than that of one manufactured by Frankenstein's mosaic process, because the former method is more like the process of natural evolution with which, in our generation, everybody is familiar. It is, therefore, more conventional. On the other hand, the far more pleasing story of Pygmalion, who carved a female statue, into which the gods infused the breath of life, bears no relation to nature at all. It is sheer fancy—but is it not also conventional? In the one case we have to do with familiar facts; in the other with familiar fables. The gods were continually metamorphosing human beings into other objects—Daphne into a laurel, Actæon into a stag, Arethusa into a fountain—and the case of Galatea was merely the reverse of this process. Mythology never stoops to explain the scientific details of these miracles.

Does not the incongruity of science with art—so far as it exists—depend upon the fact that art is essentially conventional, and science frankly unconventional?

Naval and Military Notes

Life of a 12-inch Gun.—Sir Robert Hadfield, the noted English maker of projectiles, is authority for the statement that the useful life of a modern high-velocity gun is about three seconds. Which is to say that the time taken by the shell in traveling through the gun, from powder chamber to muzzle, multiplied by the total number of rounds that can be fired before the rifling is so worn as to impair the accuracy, gives a total useful life of only three seconds. Rather a short life for, let us say, a 12-inch gun costing from $50,000 to $60,000.

"Pork Barrel" versus Preparedness.—That was a brave speech of Senator Tillman against the $40,000,000 "pork barrel" measure, known as the River and Harbor Bill. Highly patriotic it was for this veteran party man to come out so boldly for a broad National vision, amid the welter of narrow, parochial talk with which Congress is being deluged just now. Such harbor improvements as the deepening of the East River approach to the New York navy yard are of national importance. For such improvements, and for none others, should moneys be voted in the present world crisis.

Torpedo Defense for Battleships.—The ever-increasing power and range of the torpedo and the inability of the net to stop these terrible weapons have called for some permanent defense, exterior to the ship, which may be carried when the ship is traveling at high speed. A substitute for the net is found in providing a fixed outer shell conforming to the contour of the ship's sides and carried several feet distant from the hull, the water being free to pass between the shell and the hull. This construction has been used on the new British monitors.

Infantry Steel Helmet Has Come to Stay.—The reintroduction of the medieval steel helmet by the French has been followed by its adoption by the British and the Germans. The helmet is being issued to the British troops at the rate of 50,000 a month. It is flatter, or of lower pitch, than the French helmet and has no flutings. Between the helmet and its double lining of felt and wadding is fixed a number of rubber studs, which take up the shock of a blow. The wadding comes next the head, so that in case of penetration and a resulting scalp wound it acts as a dressing.

Powder Pressure in Guns.—The 42-centimeter and other big guns, so often referred to in this war, are howitzers, of low velocity (say 1,000 to 1,500 feet per second) and using low powder pressures in the powder chamber of about 14 tons to the square inch. The high-velocity naval and coast-defense guns have velocities of from 2,500 to 3,000 feet per second, and powder pressures of 18 to 20 tons per square inch. J. A. Longridge, the father of the wire-wound gun used so extensively by the English, stated many years ago that guns could be built to stand 30 tons pressure. Maybe; but what about the attendant erosion?

A War Test of the National Guard.—At the very time that Congress was passing its Army bill, authorizing the federalization and enlargement of the National Guard, the readiness of that organization to respond to the call of the country was being put to the test on the Mexican border—with the usual result. There has been delay, reluctance, and, in some cases, positive refusal to respond. It is the old, old story of the militia, as recorded over and over again in our military history. The experience of General Washington in the Revolutionary War, the breakdown in 1812, the failure in the Civil War, bid fair to be repeated in the present Mexican crisis.

Decisive Effect of Heavy Field Artillery.—The Germans and Austrians foresaw the controlling effect which heavy, mobile field artillery would have in future warfare, and they prepared accordingly. Their early successes and their present unbroken front are largely due to their possession of numerous heavy howitzers, of which the Allies, up to the present, have possessed practically none. To-day this is being rectified. The French are now bringing into service their new howitzers of 14½-inch calibre. The British are receiving considerable numbers of their new 11- or 12-inch howitzer. Russia has a fair supply, much of which has come from Japan, and Italy, entering late into the war, is relatively the best equipped in this respect of the Allies.

Drydocks for Our New Battle-Cruisers ?—The Navy Department is very reticent about the designs of its new battle-cruisers, and the meager information which has been officially given out must have been a reluctant concession to the advertising proclivities of the present Secretary. It seems that the five new battle-cruisers are actually to aim at 35 knots and are to cost some $20,000,000 apiece. If so, they will displace nearer 35,000 than 32,000 tons; and even at that, if they carry ten 14-inch guns, it is a pretty sure guess that the armor protection must be very scant. It is reported that they will be 850 feet long, and for 35 knots they will need all of that. But what about docking them? The new bill should include provision for at least one 1,000-foot dock.

Science

"Fire Weather" Warnings.—The United States Weather Bureau has undertaken a study of the meteorological conditions favorable for the inception and spread of forest fires, and the district forecasters of the Bureau will hereafter issue warnings when such conditions exist. It is possible that special stations will be installed in forested regions in order to facilitate this undertaking.

A Practical Suggestion as to Combating Pellagra has been put forth by Dr. C. W. Stiles, a well-known authority on this disease, who, in pointing out the need of increasing the use of meat in pellagra districts, urges the more general consumption of rabbits and hares. These animals are prolific, easy to raise, and cheap to feed; and their use does not involve the expense of slaughtering and cold storage, as in the case of larger animals. It is now fully established that diet is a dominating factor in the cause, cure and prevention of this disease, and deficiency of meat in the diet is commonly observed where the disease prevails.

Danger in Spraying Celery.—A note from the U. S. Department of Agriculture calls attention to the fact that Bordeaux mixture, made of lime and copper sulphate, is much used to prevent the destruction of the Florida celery crop by blight, and that carelessness in the application of this mixture sometimes results in leaving excessive amounts of copper on the stalks. This appears to be often due to the use of knapsack instead of power spraying outfits, the former not operating at a pressure high enough to make a fine spray or mist. Accumulations of copper are indicated by a blue-green appearance of the base of the celery. As this deposit is injurious to health, stalks on which it appears should be thoroughly scrubbed before use, after which there will be no danger of bad effects.

A Clock Escapement of the 13th Century.—The "verge" escapement employed by Henry de Vick and other clockmakers of the 14th century was presumably evolved from some cruder device, but definite information on this subject has heretofore been lacking. Every student of this history of clocks will therefore be interested in the description and drawing of a clock more than a century earlier than those of de Vick, which M. Ch. Fremont has recently reproduced in the *Comptes Rendus* from a manuscript dating from the period 1240-1251. It is especially interesting to notice that this early timepiece is provided with a balance wheel, though it bears little resemblance to the immortal invention of Robert Hooke. This wheel is ingeniously adjusted so as to be given a to-and-fro motion by the alternate tension and lateral thrust of the cord attached to the driving weight.

Sharks and Rays as Food Fishes.—An unreasonable prejudice exists in this country against the use of sharklike fishes (sharks, dogfish, rays, etc.) as food. A recent memoir by Mr. Lewis Radcliffe, published by the U. S. Bureau of Fisheries, points out the flesh of various small species of this class is palatable, when properly prepared, and that this fact is better appreciated abroad than in this country. In England and Wales, in 1913, there were landed 64,996 hundredweight of dogfish, valued at £20,242. It appears, however, that a good deal of shark meat is eaten in the eastern United States by people who think they are eating something else. For example, trap fishermen in the neighborhood of Woods Hole, Mass., remove the head, fins and tail from all the larger species of shark (except the sand shark) caught in their traps, after which treatment the body looks not unlike swordfish. It is then shipped to Boston and New York, where it is sold as deep-water swordfish. The fishermen receive from 3 to 8 cents a pound for this class of food.

The Derailment of Railway Trains By Wind is not an uncommon occurrence in the case of light, narrow-gage railways. Mr. R. H. Curtis, writing in *Symons's Meteorological Magazine*, tells how this danger has been virtually eliminated on one such line; viz., a stretch of 36 miles along the Atlantic coast of Ireland, forming part of the West Clare Railway. Probably there is no other line in the British Isles exposed to such violent gales, and during a few years prior to 1909 as many as five "blow-offs" occurred, in which the carriages were completely smashed though there was fortunately no loss of life. In that year Mr. Curtis devised for the railway a pressure-tube anemometer, with electrical apparatus for giving two warnings by ringing a bell in the station-master's house at Quilty; the first when the velocity of the wind reached 65 miles an hour and the second when it reached 85 miles an hour. When the first warning is given, 2,400 pounds of movable ballast, kept for the purpose at every station, is placed on each vehicle of any train on the line at the first station it reaches. When the second signal is given, trains are stopped until the storm abates. Since the apparatus was installed, in December, 1909, there has been only one storm-derailment, and this was due to deliberate disregard of the signals.

Industrial Efficiency

Serving Lunches to Hold Employees is but one of the many successful plans a Baltimore clothing manufacturer is using at the present time. Lunches are brought to the employees at their machines and benches by a colored maid, who also takes the orders that are filled in the company's lunch room. The food is served at practically cost price. Not only has the manufacturer found this plan profitable in that the workers materially increase their daily output, but he has also succeeded in obtaining additional skilled help from time to time even in the face of labor shortage.

Crushed Coal in Smelting.—A new method of utilizing coal in competition with oil fuel is being tried at Vancouver. Those conducting the experiments claim that crushed coal can be supplied to steam-producing furnaces by the same method that oil is utilized. The new process is of special interest to British Columbia, as it is proposed to apply it for smelting purposes in the big mining plants of the Province. It is claimed that seven tons of copper ore can be smelted with one ton of coal by this process, whereas formerly the ratio was a ton of coal to a ton of ore.

A Road Contractor's Ingenuity was recently displayed when he converted his chain belt paver into a roller. Owing to the fact that shipments of coarse aggregate were delayed on the work at hand, he made use of the time by rolling the entire sub-grade with his mixer. Over the regular wheels he slipped one half inch steel tires, 30 inches in diameter and 24 inches wide. The outer half of each tire was filled with cement and sand, mixed one to two, respectively. The entire expense was approximately $75.00, which sum would have been spent in shipping a roller for this work. It is reported that excellent compression on the sub-grade was obtained.

Barging Lumber Across the Gulf.—The lumber trade of Cuba and other islands of the West Indies, which has been depressed for the past year, is reviving rapidly. The demand is mainly for long-leaf pine, and it is beginning to move in quantities out of Pensacola, Mobile, Gulfport, and New Orleans. The abnormal scarcity of bottoms and prevailing high freight rates are retarding factors to a larger increase in the business. Illustrating the straits to which some of the shippers are put and the resourcefulness of some firms, lumber is being loaded on barges at Pensacola, Fla., and towed by tugs the 515 miles across the Gulf of Mexico to Havana.

"Safety First" in Steel Mill Yards.—There is a tow car now in use in the open hearth stock yards of the Gary Works, which is proving to be a success as an accident preventer. The tow car was designed and built at the works so that an entire train of charging buggies can be equipped and operated by automatic couplers, while the danger of switchmen getting their hands caught between draw heads at the engine and buggies is said to be eliminated. The end of the tow car next to the engine is equipped with a "Jenny" coupler and is always coupled onto the engine. The other end of the car has an automatic coupler which can be coupled onto the charging cars, all of which have automatic couplers.

American Clay in Paper Making was the subject of a recent conference between representatives of clay-mining companies and of the United States Bureau of Standards. It was shown that several mills in this country were using American clays with excellent results, while several others making the same grade of paper had never been able to use anything except imported clays. The facts indicate that part at least of the criticism of domestic clays is due to prejudice in favor of the imported article. Foreign clays are said to have a much whiter appearance than the domestic, yet it is definitely known that many imported clays are treated with ultramarine blue, giving them an artificial effect. It is proposed to make runs on a paper machine to determine the difference in rate and amount of settling-out of the clays, and to make tests for color, per cent of grit, ease with which the clays mix with water, and other significant tests.

Use of Flint Pebbles in Manufacturing.—The flint pebble industry gives occupation to many women and children along the French coast lying between Havre and Dieppe. The pebbles collected in and near Havre are selected for their spherical shape, and are used exclusively for pulverizing in certain industries, particularly in the manufacture of cement, and in copper mines, being employed in the interior of large cylinders. In the cement industry the slow turning of the pebbles produces a powder which becomes an ingredient of the cement, while in the copper industry the metal is freed of all impurities by the grinding operation. The same kind of pebbles is used for crushing purposes in the manufacture of paint. Another important use of flint pebbles is in the manufacture of porcelain, the pebbles for this purpose being found between Fécamp and Calais. In the latter case the pebbles are pulverized before using.

Realizing Industrial Preparedness

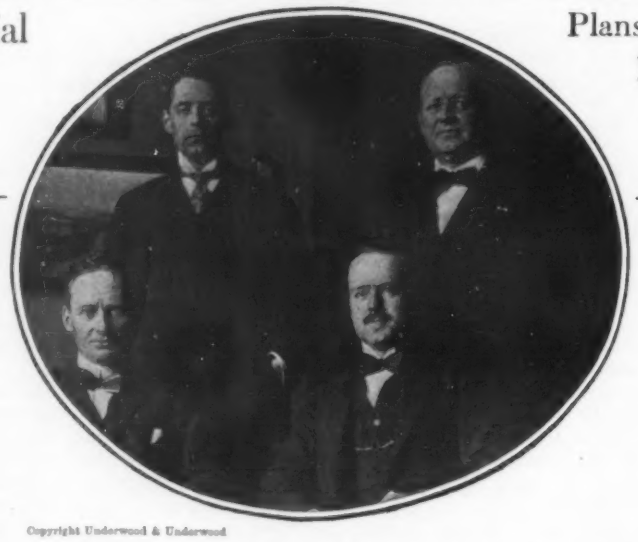
An Inventory of Our Resources

Plans for Mobilizing American Industries in Time of Need

By W. S. Gifford

[The author of the following article is the Chief Statistician of the American Telephone and Telegraph Company. Mr. Gifford is acting as Supervising Director of Committee on Industrial Preparedness of the Naval Consulting Board of the United States; and special interest is lent to what he has written when it is stated that, in common with his associates in this patriotic work, his time and labor are entirely voluntary.

Since the article was written the Army Reorganization Bill has passed the House and Senate. While much of the necessary legislation is covered in this bill, it unfortunately fails to provide for the placing of the annual educational orders except "in time of war or when war is imminent," so that the legal authority for final and complete realization of Industrial Preparedness is still to be obtained. —EDITOR.]



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The naval consulting board's committee on Industrial Preparedness

Seated left to right: Howard E. Coffin, Chairman; W. S. Gifford, Supervising Director. Standing left to right: Grosvenor B. Clarkson, Director of nation-wide educational news campaign; W. A. McKenzie, in charge of statistical detail.

ONE lesson stands out from the experience of the countries engaged in the European conflict and that is—that defense is not obtained to-day by fighting *men* alone but by fighting *industries*. Behind every man in the firing line in Europe from three to five persons are employed to supply him with food, ammunition and other needs. To-day two thirds to three quarters of all the industries of the fighting nations are engaged in meeting the tremendous requirements of the battle line. Phonograph concerns are making shell parts, manufacturers of infants' food are making plugs for shells, watchmakers are adjusting fuses, in short all kinds of industry are at work doing their part in the fighting line of industry.

Whether one is a pacifist or militarist, or among that 98 per cent of the American people who are neither one nor the other but simply advocates of preparedness for defense, no objection can be or is raised against industrial preparedness. It is cheap, comparatively simple and accomplished without the clanking of sabers or the glamour of martial spirit. It is the foundation for any and every plan of true preparedness for the defense of this nation. Its by-products in the way of advantages in time of peace make it worth while even though it were not necessary as an insurance against war.

The lessons to be drawn from Europe show also the danger and loss due to unavoidable delay in providing munitions if a country is industrially unprepared. The necessary steps for industrial preparedness are a cheap enough form of insurance against such possible danger and loss. The accomplishment of true industrial preparedness, as shown by the experience of European countries and of manufacturers of munitions in our own country since the outbreak of the war can be and is being achieved by three steps.

First. A complete census or inventory of the producing resources of the country. In the immediate work in hand this is limited to a complete inventory of industrial manufacturing establishments and principal mines. Other resources are needed, but the information already available regarding other resources is more complete than that regarding the manufacturing resources, so that their omission for the present from this first immediate step is justified.

Second. The placing, in time of peace, with hundreds or even thousands of manufacturers, widely distributed geographically, of minimum annual *educational* orders for army and navy supplies. Experience has shown that the one great cause of delay in the quantity production of supplies for the armies of Europe has been the lack of knowledge on the part of the manufacturer as to how the particular article wanted should be made. By making a few of these articles each year in time of peace, the foremen, and those holding positions of responsibility, will become acquainted with the peculiarities incident to their manufacture, and the entire organization of the factory, including the purchasing, manufacturing, inspecting, shipping and engineering departments, will be made familiar with the work. Payment for these orders on the basis of actual cost of production, inclusive of all special tools, jigs, etc., plus a reasonable profit, should sufficiently compensate the manufacturer and will go far to supply, at a reasonable cost, the current or peace-time needs of our regular army and navy. Every manufacturer carries insurance against fire; he must carry insurance against war. The inconvenience in handling these small educational orders is a very small price to pay for such insurance.

THE WHITE HOUSE
WASHINGTON

April 21, 1916.

To the Business Men of America:

I bespeak your cordial cooperation in the patriotic service undertaken by the engineers and chemists of this country under the direction of the Industrial Preparedness Committee of the Naval Consulting Board of the United States.

The confidential industrial inventory you are asked to supply is intended for the exclusive benefit of the War and Navy Departments, and will be used in organizing the industrial resources for the public service in national defense.

At my request, the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Chemical Society are gratuitously assisting the Naval Consulting Board in the work of collecting this data, and I confidently ask your earnest support in the interest of the people and government of the United States.

Faithfully Yours, Woodrow Wilson

A letter from the President of the United States

Third. The enrollment of skilled labor in an "Industrial Reserve" in time of peace. The industrial force has become quite as important as the fighting army. Skilled mechanics in all lines of production must be kept from enrollment in the army, and in time of war must be retained in the factories, mills and mines for the production of munitions. To this end, these skilled workmen must be listed and the men themselves enrolled in the "Industrial Reserve." The only restriction imposed on the men through such a process will be the prevention of enlistment in the fighting army. In the event of war, it is proposed that a button or other distinguishing mark shall be supplied by the Government to skilled workmen enrolled in the "Industrial Reserve," and such enrollment will be considered to carry with it honors equal to enrollment in the fighting forces.

Although not directly concerned in the three steps mentioned, ownership by the Government of certain supplies of tools and gages, which could be distributed in time of war to assist in prompt *quantity* production of munitions, is undoubtedly desirable.

The advantages of the foregoing programme to the country as a whole are obvious. The plan is cheap, it results in the education of manufacturers all over the country, and it lays, once for all, the ghost of the munitions trust, for no one firm or group of firms would find it commercially to their advantage to advocate war. When it is considered that the producing resources of the United States are greater than any other two countries in the world, and when it is considered that availability of these resources under this plan will be widely distributed geographically, what better insurance against attack could be written? To the skilled laborer the enrollment in an "Industrial Reserve" means that he will not be sent to the firing line but kept with equal honor in the industrial army at home. It means to the banker and manufacturer, as well as to the laborer, that unemployment and the suffering therefrom, due to the outbreak of war, will be reduced to a minimum and that all sections of the country will have work to do, labor will be kept on the job, and the wrench to the industrial system will be greatly lessened. It makes possible, if not probable, the retaining in private hands of the work of supplying the country's needs in time of war and, in this way again, it would prevent any serious disarrangement of the economic system. The individual manufacturing plant will, under this educational system, be in a position to swing quickly from its regular commercial line onto that kind of government work for which its equipment has been found to be best fitted.

The method for accomplishing the three steps mentioned has been worked out carefully and the end is fast being accomplished. It is a most democratic and American way of doing the job. A committee of the Naval Consulting Board of the United States, known as the Committee on Industrial Preparedness, of which Mr. Howard E. Coffin is Chairman, is the directing body. This Naval Consulting Board, appointed by the Secretary of the Navy, is non-partisan and composed of men of the highest ability, who act in an advisory capacity to the Government without pay and from purely patriotic motives. At the request of President Wilson, five great engineering societies—the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Chemical Society—have pledged their assistance to the work of the Committee on Industrial Preparedness. The first immediate step is to take a census of our industrial resources. For the accomplishment of this, the five engineering societies have each nominated one man in every state to represent them in the work within that state. These five men in each state constitute a Board of Directors for the state and have been formally appointed by the Secretary of the Navy as Directors of the Organization for Industrial Preparedness and Associate Members of the Naval Consulting Board. These Boards of Directors have all organized, held meetings, appointed their chair-

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The Technically Trained Foreman

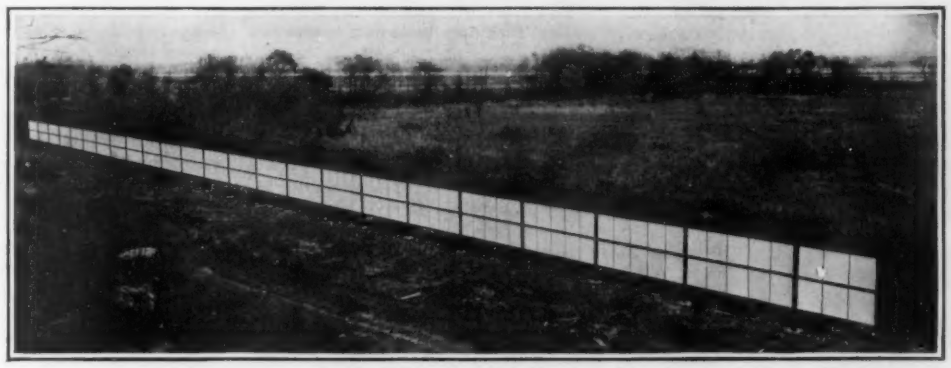
How One Deficiency of Our Educational System is Being Made Good

By Allan Rogers, Pratt Institute, Brooklyn, N. Y.

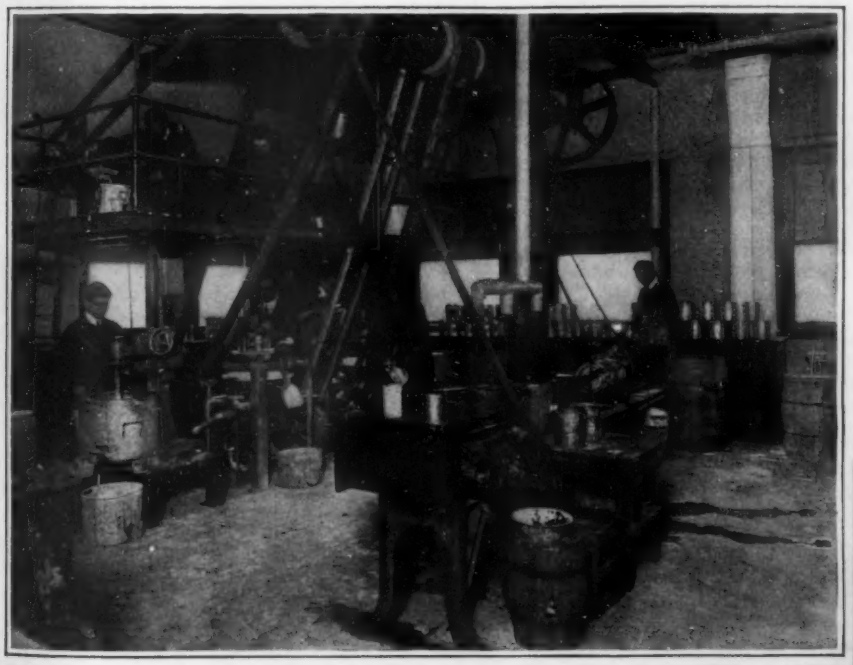
FOR the past few years the attention of manufacturers and educators has been drawn to the problem of training young men in such a manner as best to fit them for our great and rapidly growing chemical industries. The conditions arising are being met in part by the excellent courses in chemistry and chemical engineering offered by our technical schools and by the magnificent research work being done in some of our leading universities, while in certain lines the trade schools and vocational institutions are playing an important part.

But between the research chemist and the chemical engineer, on the one hand, and the skilled worker on the other, there exists a field which is not being filled by men who have had a training along any of the lines mentioned. This field relates to the supervision, by foremen, etc., of operations carried on in the plant. These positions, as a rule, are held by men taken from the works. In the majority of cases they are ignorant of the basic principles involved and are often not in sympathy with the ideals of the scientifically trained man. It often happens that a great part of the chemist's work goes for naught because of the tendency of the "practical man" to discredit anything that may have been suggested by the chemist of the plant. And, on the other hand, the chemist is apt to look severely down upon even ignorant workmen to understand or execute complicated processes developed only by years of hard thought and untiring effort?

The colleges and universities are steadily increasing their requirements and are continually raising their standards in order that they may develop the highly trained scientist and investigator. Thus our educational institutions have been turning out thousands of young men each year, many of whom have found their way into lines of industry. These young men have become the backbone of the industry into which they have entered and have built up a magnificent structure, of which we are justly proud. We cannot help but wonder, however, if the market is not becoming flooded with an over-production of material for which we have only a limited demand. For every position as research chemist or laboratory worker there are scores of places as foremen or superintendent, equally remunerative, equally desirable scientifically, far superior in prospects of advancement. And yet no effort is made to prepare even the ignorant practical person, and refuse to take his problems seriously. In either case the chemist is worse than useless. The more he understands of the manufacturing operations with which he is concerned, the more valuable he will become to the owners of the plant; and when he goes into the factory he must meet with coöperation, not with opposition and abuse. This condition, however, will never be obtained until we have provided our factories with technically trained foremen, for then we will have a class of men who will be in sympathy and work in harmony with the chemist.



Test fence painted with paint from Pratt Institute



Model paint factory at Pratt Institute

To bring about this condition we will be forced to consider more seriously the question of industrial education for the great army of workers who fill these minor though very responsible positions. It may not sound so musical to the ear or tickle our imagination of the glorious so much to talk about training of foremen as it is to speak of the beautiful ideals of higher education, but our glorious ideals and higher education will be of little value if we do not have intelligent supervision of the wonderful processes we have so ably devised. How can we expect untrained, unskilled and superficially for these positions.

Scientific education is of value to mankind only in so far as it can be applied to the benefit of humanity; but to apply this scientific knowledge requires men who are fitted to do so. The greatest discovery is worthless unless properly applied. We are training too many discoverers and too few men to put their discoveries into application. Hundreds of plants are crying for intelligent supervision. These plants offer positions of responsibility and trust which should be, and in the future will be, filled by men with technical training. When the time comes that we have men in our plants who can think along technical lines and who can work in harmony and in sympathy with technically trained men higher up, we will be able to get the full benefit of the research chemist's knowledge, carry out the ideas of the chemical engineer, and profit by the findings of the works chemist.

In dealing with this, as with any productive problem, the first and most important matter to consider is that of raw material. Where shall we get this raw material? The answer is an easy one. We should look for it in the high schools of the country. The majority of young men and young women are in a very receptive mood at about the high-school period in their career; this is the time to impress upon them what the future may hold in store. A good impression and a created interest at this critical period would cause many an uncertain youth to turn the latter part of his high-school course into new channels, where he could more clearly see his way to advancement and prosperity and economic service. The manual-training system, as conducted in many schools, has this end of view, but falls short of the mark, in that it brings out only the mechanical side of the problem. To accomplish the result desired, in the writer's mind, it would not be necessary to convert our high schools into trade schools, but merely to pay a little more attention to the practical things of every-day life.

Few indeed are the high-school students to-day who realize that the United States is the greatest manufacturing country in the world; and it is safe to say that not one out of a hundred knows that every article of his clothing, the food he eats, the paper upon which he writes, the pavement upon which he walks and the decoration of his home are the result of chemical industry, brought to perfection through chemical treatment and control. These things should all be brought out. In addition to the simple facts as ordinarily taught in a course of general chemistry, the teacher could impress upon the student that each item has some practical application, and frequently the class might

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Students from tanning course doing construction work in new tannery

A Census of Colors

What the Government is Doing to Aid the Dyestuff Industry

By Prof. Thomas H. Norton, Ph.D., Sc.D., Bureau of Foreign and Domestic Commerce, Wash. D. C.

THE idea conveyed by the word "census" was, until a recent period, of an extremely restricted nature. For centuries it was limited to the simple enumeration of the population.

During the nineteenth century the scope of a national census was gradually broadened, until now, in most civilized countries, it embraces a great variety of data. The population is not simply numbered; it is also classified from many standpoints; nativity, literacy, marital condition, occupation, etc. Our Bureau of the Census studies every phase of the material, industrial and intellectual life of the American citizen. Each ten years it takes a complete inventory of the nation's wealth and assets.

New subjects for careful enumeration and classification are making their appearance, as sociology and economics seek concrete forms of expression. Census-taking is no longer an exclusively national function. It is frequently executed by state or local officials, or on private initiative.

The recent census of wild birds is an interesting example of a novel and fascinating field for statistical study.

Almost as picturesque is the latest subject for census-taking undertaken by one branch of our Government. It might be termed by a feuilletonist as the rainbow census. In fact, it deals fundamentally with the infinity of tints constituting the visible spectrum of the solar rays, included between "ultra red" and "ultra violet."

In more prosaic phraseology it is termed a census of the coal-tar dyestuffs consumed by the American people; and it is compiled by the Bureau of Foreign and Domestic Commerce.

So much interest has been excited in chemical circles by the announcement of this new phase of the Bureau's many-sided activity, that a detailed statement is in order.

Necessity of the Census

The necessity for a complete enumeration of the artificial coloring matters regularly consumed by the various manufacturing industries of this country soon became evident when these branches were threatened in 1914 by a dyestuff famine, as a result of the great European war.

Those who took into careful consideration the possibility of creating an independent American coal-tar dyestuff industry were obliged to study closely a number of factors bearing upon this exceedingly complicated question.

Among these were such items as the supply of crude materials, the chemists and chemical engineers available, the probable attitude of the European interests hitherto furnishing our synthetic dyes upon the return of normal international conditions, the requisite fiscal and other legislation essential to safeguard American enterprise and capital against unfair competition on the part of such foreign rivals, etc.

First and foremost, however, came the factor of *quantity*. What is the total annual consumption of artificial colors in the United States? How many different dyes are in current use? What is the average annual consumption of each of these dyes?

The necessity of exact information on these three points is self-evident to some. For most a brief explanation may be helpful.

In a general way we know how the great dyestuff industries of Germany and Switzerland are organized. We know the relations of capital, of technical staff, etc., to output. From an economic standpoint it is necessary to know the total extent of the American market for this class of wares, in order to estimate approximately the amount of capital required for a comprehensive industry, the number of trained chemists and engineers needed and the quantities of coal-tar crudes to be provided. These form the main links in the chain connecting the gas works and the coke plants yielding coal-tar and the gases laden with benzene and its homologues, with the multitude of mills and shops in which synthetic colors are employed to produce chromatic effects upon wares of the most varied nature—paper, textiles, leather, wood, ink, varnish, fur, feathers, foods, beverages, etc.

While such leading data are of prime importance from a general economic standpoint, of still greater value are the details concerning the specific products of the synthetic color industry.

There are nearly 1,000 coal-tar dyestuffs of recognized standing in the tinctorial world. Many of these are encountered commercially in the form of several marks or brands. These represent slight modifications of the primary dye, some times in regard to shade, often in regard to convenience of application. The form in which a dye is prepared for use on cotton may not be the best form for the needs of the silk dyer. The requirements of the feather dyer may be quite different from those of the manufacturer of ink.

It is essential that the organizers of a national color industry must know, with a certain approximation to accuracy, how much annually is consumed of each primary dye, and how much of each minor modification is employed. Without such data he is at a loss to calculate the size and number of the units to be constructed for the production of any given dye, and he is at an equal loss as to the equipment necessary to manufacture it in the different modifications of current use.

Again the industry is one of great complexity, involving a high degree of coördination and of careful planning to avoid material loss in the way of by-products. In the various steps intervening between a coal-tar "crude," and a finished dyestuff each chemical reaction in the sequence is apt to produce certain percentages of closely allied compounds, isomeric substances as a rule. These latter may possess the same general chemical composition as the product more directly sought. The arrangement of the atoms in the molecule is, however, quite different. As a result, physical and chemical properties are totally unlike those characterizing the main substances. By-products possess, as a rule, distinct technical and commercial value. One may serve to make an entirely different dyestuff, another may be the raw material for manufacturing a valued medicinal; a third may be employed in the production of a photographic developer, etc.

It is evident, therefore, that the establishment of a synthetic color industry means an elaborate study of a multitude of interrelated operations, allied furthermore with numerous products in a group of closely connected industries, based likewise upon the use of coal-tar crudes. To some extent the changing whims of fashion enter into play. Back of every plan and calculation stands, however, the dominant factor of *quantity*.

It is now generally recognized that any intelligent effort to build up a comprehensive, self-contained American coal-tar chemical industry must rest upon the solid foundations of accurate, statistical data concerning the American market for artificial colors. In no other way can the creators of such an industry avoid duplication, over-lapping, waste, and blundering, tentative struggles to adjust productive mechanism to a vague, indefinite demand. Without such fundamental data the future industry would be heavily handicapped by permanent overhead charges, accumulated as the result of being forced to feel its way in the dark, chemically, mechanically, commercially.

If the coming American dyestuff industry is to hold its own successfully against foreign competition, it must be free from any unnecessary shackle. It must start into existence during these years of crimson-splashed struggle for Europe—of golden opportunity for this Republic—at the point where a brusque order to halt has been given the giant factories on the Rhine, the Main and the Spree. It must utilize to the full all the gathered stores of experience, accumulated during the six decades since Perkins's epochal discovery and become a world factor in the seventh period of the history of synthetic color at whose portal we now stand.

The data of quantity constitute the warp. The shuttle of American enterprise and talent will flit swiftly back and forth carrying the threads of past experience, weaving the many-colored fabric of the nation's new industry.

Early in 1915, the embargo came into force, shutting off German dyes from this country. Long before, the relatively small supply of colors, from England, France, Belgium and Holland had practically ceased, and the somewhat more important source in Switzerland was threatened with paralysis.

The Bureau of Foreign and Domestic Commerce in Washington was following with the keenest interest, and even with anxiety, the initial steps taken bravely and resolutely by a small band of far-sighted American men, some manufacturers, some capitalists—all patriots—convinced that finally the opportunity had arrived, to build up a genuinely national coal-tar chemical industry.

In the earnest desire to second their efforts and facilitate their plans, as well as to ensure the most favorable and economical conditions for the rapid evolution of the new industry on a permanent basis, it was promptly recognized that nothing could be of such direct assistance as a "census" of the dyestuffs consumed normally in this country. Plans were carefully laid to carry out the work as expeditiously, accurately and fully as the very limited appropriations at the command of the Bureau for such general purposes would permit.

How the Census was Taken

First of all it was necessary to decide upon the *modus operandi*. It has been suggested by some who had early recognized the desirability of such a "census" that the only available method for securing the needed data was to appeal to all consumers of artificial colors for their coöperation. It was thought that a ready response would be given to circular requests for detailed information regarding the annual consumption of coal-tar dyes by each user of the same. It was proposed, in order to overcome the customary repugnance of manufacturers to communicate facts of this nature, that the replies should be sent to some central financial institution, which would guarantee secrecy in collating the numerical data received.

A careful analysis of the problem showed that any such method of collecting data was impracticable. It would be impossible to secure a complete list of all users of dyestuffs, in scores of trades and manufacturing branches. Assuming that figures could be secured from *all* users of colors their compilation would be a herculean task. Suppose that five tons of Congo red are consumed annually in this country. This amount might be divided up among several thousand consumers in lots ranging from five to one hundred pounds.

With a somewhat elementary knowledge of human psychology it was furthermore certain that no replies could be expected from the great majority of the recipients of circular requests. Indifference, suspicion or pure laziness are serious factors to overcome.

The correctness of this conclusion has recently been abundantly verified by transatlantic experience. British textile and allied interests have been forced to deal with a far more serious "dyestuff famine" than has been the case in the United States. There was a similar determination to build up a genuinely national color industry. The necessity of a dyestuff "census" was likewise recognized as of paramount importance. An influential committee, representing makers and consumers of dyes, took the matter in hand. Appreciating the futility of dealing directly with the multitude of individual users of colors, the committee decided to collect its statistics through the various powerful organizations of trades employing large quantities of dyestuffs and then double the results, thus roughly approximating at the entire national consumption of the various colors. After months of labor the committee has been forced to report a practical fiasco. Replies were secured from but nineteen associations or large individual consumers. The figures obtained covered but 3,145 short tons, perhaps 12 per cent of the national consumption.

The method adopted by the experts of the Bureau of Foreign and Domestic Commerce was much more simple, direct and accurate. As in the case of Great Britain, nearly nine tenths of the normal American consumption is derived from European sources. It was decided to use the data covering the imports of artificial colors into this country during the 12 months ending June 30th, 1914—a month before the outbreak of the present war. The remaining tenth is covered by the returns of the Bureau of the Census for the domestic coal-tar dyestuff industry, covering the production of the calendar year 1914. No serious interference in the output of American colors occurred until after the beginning of 1915.

With the cordial coöperation of the Secretary of the Treasury, all the invoices for the year in question were sent by the Collectors of Customs at the various ports of entry to a central point, where the essential data were transcribed. These include weight, value and price. Some 37,500 different entries, each covering these three items, were necessary.

These entries are found under about 6,500 heads, each representing a distinct commercial designation. It must not be inferred, however, that 6,500 different colors come into consideration. Many standard dyes are manufactured by a number of firms in the same country as well as in various countries. Frequently, several or all of the competing manufacturers use entirely different trade names for identical wares.

Thus, the red color, known chemically as sodium α-naphthalene-azo-α-naphthol-disulphonate, is manufactured under the name of Palatine Red by the Badische Company. The Bayer Company sells it under the name

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Strategic Moves of the War, May 26th, 1916

By Our Military Expert

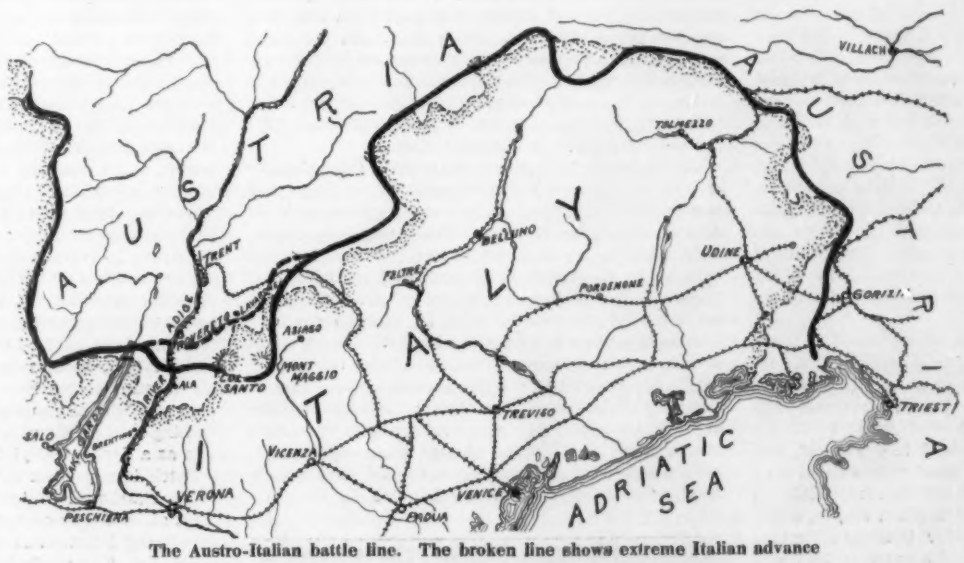
IN contrast to the lack of the spectacular which the late weeks of the war have demonstrated, the week just passed has been marked by the development of a great Austrian offensive in the Trentino, the resumption of terrific attacks by the Germans upon Hill 304 and Mort Homme and the reported junction of Russian cavalry with the British forces in Mesopotamia, in the vicinity of Kut el Amara.

The Austrian campaign in Italy has not as yet developed sufficiently, nor gained enough material ground to render analysis of the operations feasible; for at this distance and with only the meager reports which have been permitted to pass the various censorships, little is now known in this country of the actual situation.

Almost inch by inch, by dint of an arduous campaign which covered months, the Italian forces had pushed their lines closer to Rovereto in the campaign against Trent. In ten days, an Austrian force estimated at 800,000 men, backed by a powerful massing of artillery superior in numerical strength and caliber to the Italian, has thrust back the forces of Italy along a front of approximately 60 kilometers, to a distance varying from that between two lines of trenches to eight or nine kilometers, while east and southeast of Rovereto, the Italian frontier has been invaded in at least three places.

Austrian forces are reported to dominate the entire Lavarone plateau, with the Col de Santo and Monte Maggio, commanding eminences, also in their hands.

This thrust to the south and southeast, if successful, must have for its ultimate military object the isolation of the Venetian peninsula; and when it is considered that the bulk of the Italian army in the field is embraced within this territory, the menace of the attack becomes very apparent. There is a marked similarity between the strategy employed at Verdun and that recently developed in the Trentino. Verdun is in the heart of a salient, both sides of which are subject to attack, either of which might be crushed in by a success; the Venetian peninsula is guarded on the east and southeast by the Adriatic, but the Italian-Austrian frontier, which in general coincides with the battle lines, forms the upper leg of a salient. The thrust is at the base of the salient, more directly upon Verona and Vicenza, railway bases which supply the main Italian base toward Gorizia on the east, and to which the greater portion of the Italian army looks for its needs.



The Austro-Italian battle line. The broken line shows extreme Italian advance

The strategy is without doubt of the soundest; a glance at the map will make this apparent to the veriest layman. But because the Austrians have attacked in strength and have gained a comparatively small amount of difficult ground, this does not mean that it will be an easy matter for their forces to sweep onward. The entire territory embraced between the lines is about as difficult as any in existence, and when the problems of transportation and supply are considered, it is clear that even if the Italian defense should materially weaken, an improbability, it would necessitate considerable time even to shift the great guns forward to new emplacements from which to pound to a pulp another position in advance. This massive artillery has been the secret of the entire affair, the war, even from the beginning. The same great howitzers and field-mortars which made the Austrian advance against this terrific terrain possible, proved themselves the key which unlocked the defenses of Liege, Namur, Maubeuge and other points. The steel cupolas could not withstand them; but without their great guns, the Germans would have been held at least for a longer time by the Belgian fortifications.

The entire artillery arm of the Austrian forces is greatly superior to the Italian, not only on the Alpine battle line but in general. The Italian field material, practically the same as the famous "Seventy-Fives" of France, is a better gun than any the Austrians have of its class and caliber, but the disparity in numbers is great. And while Italy owns a certain number of larger pieces, notable many which have been turned out since the great struggle broke in August, 1914, Austria had a tremendous advantage in this respect from the first and it has been increased in proportion since the outbreak of hostilities. It seems rather evident that Italy has not gone into the prosecution of her war whole-heartedly, apparently being willing to let things drag along, seeming hopeful of making her own immediate gains by a "ride upon the coat-tails" of her Allies. Only a few months ago a whole class which had been called to the colors was granted furlough. Italy's attitude is further shown by her strange relationship with Germany, with whose ally she is at war and who is at war with Italy's allies; and Italian reluctance to participate in the Balkan imbroglio when, it is believed, decisive action on her part might easily have saved Serbia, adds point to the complication. It is one of the weirdest situations in all history.

Apparently this sudden swoop upon her by the Austrians is the price Italy must pay for her lackadaisical belligerency. The constant effort of the Central Powers has been directed toward the elimination of at least one national foe, first France, then Russia—without success. Italy, being the weakest great link in the alliance, and having been further guilty of keeping about 400,000 Austrian troops from the Russian battle line, now comes in for her turn, with always in view the possibility of a success which would release these Austrian troops for service elsewhere, a tremendous gain for the Kaiser when it is remembered that reserves are become exceedingly scarce. And a victory over Italy would strike a rather stunning blow to Entente morale and possibly effect the same gain which was hoped for in the event of a decision favorable to Teutonia accruing at Verdun.

Italy is not so far damaged by the invasion save in her pride and possibly in morale; her Allies suffer from this, in this respect, as much as she. But as things do not always pan out as anticipated, there may be a hoist with the attacker's own petard, exemplified by a full arousing of the Italian people and authority to the danger of dilatory methods and the real threat which seems to confront their state. The greatest saving factor the Italians have is that of time—the time which is necessary for the shift of the guns. The hoist would come if Italy should be so awakened by her danger that the nation would respond to a man and really go to war, thereby preventing a later detachment of Teutonic troops to other points, upsetting plans of strategy which challenge the awed admiration of the world.

There is another reason which may account for the sudden activity against Italy. So far, the Central Empires have retained the initiative, a tremendous advantage in war, for it keeps the enemy in doubt, makes him chary of changes of disposition of troops and compels him to follow the lead of the country on the offensive. Verdun, it seems rather definitely settled, has not yielded the fruits expected, hoped for, to the Kaiser, the dominant factor in his alliance; but the German staff has no mind to relinquish its initiative advantage on that account and, in consequence, Italy may serve to retain this. The forces of the Entente have been steadily gaining strength in relative man-power and material, evidently in anticipation of the wresting of the initiative from its foes. The Entente may assume the rôle of the offensive almost any day; but it will not be a true offensive so long as Teutonia is attacking, for it must first represent only a counter-attack, an offensive return.

At Verdun, the Crown Prince continues his efforts to break in the French salient at Hill 304 and Mort Homme. It seems a hopeless task, so often has he failed; but stranger things have happened in war than the sudden collapse of a stout defense.

French activity has been renewed and the latest dispatches indicate the recovery of Fort Douaumont, the only permanent fortification of the Verdun enceinte which has fallen into German hands. As a point of military value, Fort Douaumont is nothing; but from the standpoint of sentiment—which makes morale—its recovery means much to France. Whether the French forces will manage to retain it is another question which only the future can answer.

The junction of Russian cavalry with the British in Mesopotamia appears to be a brilliant and daring feat of arms. In all probability this force has made its way from the vicinity of Kermanshah, probably by a wide detour to the southward, threading the dubious passes of the forbidding mountain range which parallels the Persian-Turkish frontier in Luristan, east of Bagdad. There is nothing to indicate whether this is merely a detached flying column or the immediate precursor of a strong infantry advance of which the Russian force that effected the junction is but the advance cavalry. How such an army could subsist and be supplied with munitions is a wonder. But there have been many wonderful things evidenced in the Grand Duke's campaign and it is not inconceivable that, instead of a decision being reached on either eastern or western main front, the conquest of Turkey, with the elimination of that country from the Central Alliance, might materially aid in bringing the entire war to an end.

Italy has a defense far superior to what she herself can put up if the Entente begins a widespread, masterly, consistent offensive. But the question is:

Is the Entente ready? In men? Supplies? Ammunition?

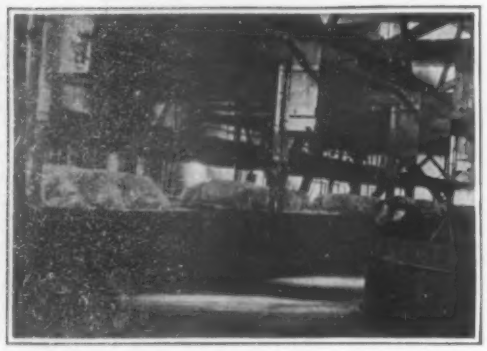
Resurvey of the Massachusetts Coast With a Wire Drag

THE United States Coast and Geodetic Survey is about to make a resurvey by the wire drag method of Massachusetts Bay between Nahant and Cape Ann, and of the western part of Cape Cod Bay between Plymouth and the Cape Cod Canal. This method has been in use for 10 years on the coast of New England, and has had important results in the Maine bays, Boston and Cape Cod bays, Buzzards and Narragansett bays, and the East River, New York. It is in use in Alaska with marked success, and has been employed in Florida, Porto Rico, and Panama.

The surveys in the vicinity of Boston last year had such important results that the work is to be continued. Several new buoys are in position, some of the old buoys have been shifted, and the accepted deep channel to Cape Cod Canal is more than a mile farther offshore than previously.

The wire drag consists principally of a long wire suspended at known depths below the surface by vertical wire cables, connecting buoys on the surface with suitable sinkers. It is towed by launches, the purpose being to place the wire at the proper depth to catch on all obstructions of less depth and to pass over all of greater depth. The maximum depth selected for the area to be dragged is 50 feet at mean low water or 58 feet at high water, wherever such depth exists. In Salem and Gloucester harbors the maximum depth will be 33 feet at mean low water.

The object of the announced work is to insure the safety of all vessels bound to or from the Cape Cod Canal, vessels bound eastward from Boston, and those entering Salem, Beverly, and Gloucester harbors.



Chestnut extract plant, North Carolina

Palmetto growth in Florida

Cutting hemlock, Tellico Plains, Tenn.

Our Present and Future Sources of Vegetable Tannins

Where the American Tanner May Hope to Find an Independent Supply of Raw Materials

By Samuel J. Record

THE tanners and dyers of the United States use annually about $25,000,000 worth of vegetable tanning materials, of which nearly one third is imported. Formerly our tanners had the virgin forests to depend upon and their use of tanning material was limited to oak and hemlock bark. The peel of these barks has gradually become more restricted and less accessible though they still remain a great source of supply. Meanwhile there has been a constant increase in the production of leather, making other sources of tannins necessary. For tanning certain grades of leather this demand is being met in part by the use of chemicals; synthetic tannins are also being perfected. Nevertheless the demand for vegetable tannins continues, especially for the tannage of sole leather, harness leather and belting.

One of the first developments to meet the changes in the tannin situation was the making of chestnut extract. Over two thirds of all the tannic acid produced in the United States is from chestnut wood and bark. The value of the extract consumed annually is about $4,000,000. The industry is confined largely to the South where the tannin content of the wood averages over 8 per cent, occasionally running as high as 12 per cent. Chestnut in the North does not contain a sufficiently high percentage of tannin to make its extraction profitable at present. Chestnut extract is used extensively in mixture with oak-bark tannin for the preparation of leather of medium grade. The future of chestnut as a source of tannin is uncertain owing to the blight which threatens the commercial extinction of the tree.

The introduction of quebracho extract has done much to supply the demand for tanning material. This extract is made from the wood of a tree (*Quebrachia lorentzii*) found in southern Brazil, Paraguay and Argentina. The heartwood yields from 20 to 24 per cent of tannin, the sapwood from 3 to 4 per cent, and the bark from 6 to 8 per cent. Quebracho extract does not contain enough of the non-tannin materials to produce of itself well-nourished leathers and is, therefore, used in mixture with other tanning materials. It was first introduced into this country in 1897 and within two years the amount used here was worth approximately $300,000. In 1906 the value of the total quantity used amounted to about $5,000,000, and in 1909 to nearly $6,000,000. The value since has remained fairly constant. In 1909, quebracho extract formed 38 per cent of the total quantity of extract consumed in this country and its cost constituted 54.5 per cent of the total cost of the extract used. The average cost per pound of the quebracho extract was double that of chestnut extract.

Red mangrove bark and mangrove extract are also imported in large quantities. In 1909, 19,000 tons of bark worth over $500,000, and 1,400,000 pounds of the extract valued at nearly $44,000 were consumed by our tanners. The use of this product is rapidly increasing and the price has risen materially in the last two years. During 1915, over 2,000,000 pounds of extract were shipped from Cartagena, Colombia, to the United States, invoiced at 2½ cents a pound. Owing to the growing demand the price of mangrove extract from that port was 250 per cent higher than in 1914. An important mangrove industry has recently sprung up in Trinidad, British West Indies. Prior to midsummer of 1915 only small quantities were exported, but during the latter half of the year nearly 2,400,000 pounds valued at $16,800 were shipped to the United States.

Red mangrove is native to the tropical tidal marshes of both hemispheres, but our present supply is derived largely from the West Indies and Portuguese West Africa. Along the Gulf of Mexico, mangrove yields, when properly cured, about 30 per cent tannin; that from Africa about 40 per cent, and the East Indian and Borneo mangrove between 30 and 40 per cent. It is not generally appreciated that in extreme southern Florida the shores are fringed with thousands of acres of red mangrove trees. Efforts to utilize this supply have been abandoned for the present, as the cost of collecting the material from the tidal swamps was too high. There appears to be no valid reason why, with the introduction of more efficient methods, this important source of tanning material could not be made readily available for commercial use in quantity.

There are numerous other trees in southern Florida which should repay careful investigation regarding their tannin content. The black mangrove (*Avicennia nitida*) grows there and produces a bark rich in tannin. This species is used extensively in British and French Guiana where it is known as courida. The white mangrove (*Laguncularia racemosa*) has much the same range as the red and black mangroves and is closely allied to South American species yielding bark valuable for tanning. The seaside grape (*Coccoloba uvifera*), the Jamaica black olive (*Bucida buceras*), the hog plum (*Spondias lutea*), and others are products of the subtropical regions of Florida that offer possibilities for the tannin supply of the future.

One of the most convenient natural sources of tannin is the fruit of *Terminalia chebula*, known as myrobalan nuts. In 1909, we consumed 18,000 tons of these nuts valued at about $30 a ton, and 1,100,000 pounds of myrobalan extract worth $37,500. Myrobalans are used extensively for dyeing as well as for tanning purposes. The tannin content of the husks is about 45 per cent and that of the stones between 4 and 5 per cent. In 1910, India exported 73,355 tons of these nuts. Myrobalan extract gives a soft tannage of rather light yellow, and is generally used in combination with other tanning materials to improve their color.

Gambier is the dried extract from the leaves of *Uncaria gambier* and *U. acida*. It is exported from Singapore in pressed blocks and cubes. In 1914, this country consumed 16,450,000 pounds of gambier costing approximately $625,000, while in 1909 the amount was only 2,640,000 pounds and the value $134,000. Gambier contains from 36 to 40 per cent of a brown tannin which rapidly penetrates leather and tends to swell it, but taken alone produces a soft, porous tannage; it is used generally in conjunction with other materials for tanning both light and heavy leathers. It is important also as a dyeing material.

Cutch is a product obtained from boiling the chips of the heartwood of *Acacia catechu*. Good cutch contains about 60 per cent of tannin but it is used largely for dyeing browns and blacks with chrome and iron mordants. The product imported under the name of mangrove cutch is an extract from the bark of the mangrove tree. The mangrove cutch is not intended

Stripping hemlock bark, Haywood Co., N. C.

Tanbark, oak growth, Mendocino Co., Cal.

Loading hemlock bark, Haywood Co., N. C.

Hemlock bark awaiting shipment, Blount Co., Tenn.

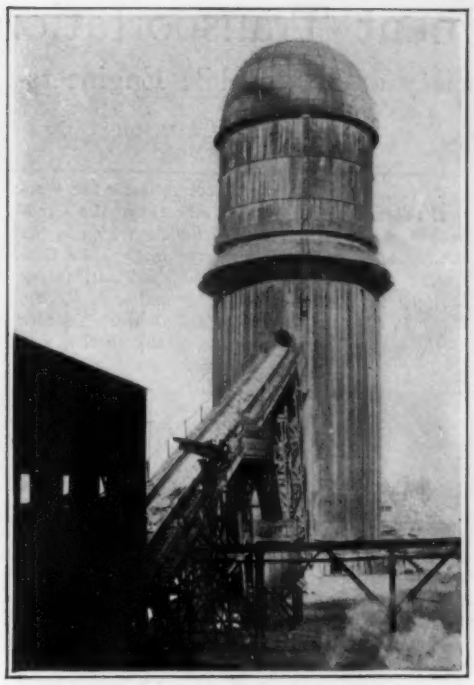
for use as a dye and its absence of color is one of its chief characteristics.

Valonia is the commercial name for the large acorn cups of certain foreign oaks, principally *Quercus ægilops*. An extract is made from these cups, which in solid form contains as high as 58 per cent tannin. It is used in mixture with other materials because by itself it produces too brittle a leather. In 1914, 7,654,000 pounds of this extract costing $116,400 were used in the United States, as against about 244,000 pounds costing $18,000 in 1909.

Gallnuts are excrescences produced chiefly on oak trees by the punctures of the gall fly for the purpose of depositing its eggs. The principal commercial kinds are oak or Aleppo galls and Chinese galls. The former develop on the buds of young branches of oak trees and, when collected while the fly is still in its larval state, contain from 60 to 70 per cent of gallotannic acid. The Chinese galls are produced on the leaves of a sumac and the best grade contains about 70 per cent of tannin. Galls are imported in rather small quantities both in a crude state and in the form of extract. According to the figures of the Department of Commerce there were shipped into this country in 1914, 47,845 pounds of the extract valued at $5,900, and 157,285 pounds of nuts valued at over $19,000.

Divi-divi is the trade name for the seed pods of *Caesalpinia coriaria*, a small tropical American tree. These fruits contain from 30 to 50 per cent of a tannin somewhat similar to that obtained from valonia. In 1914, about 22,000 pounds valued at about $16,000 were shipped into the United States. A closely allied species, *Caesalpinia brevifolia*, a native of Chili, produces pods very rich in tannin. They are known as algarobilla.

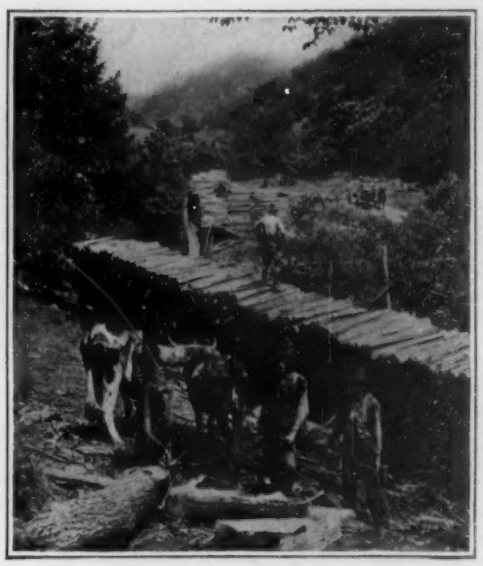
In 1913, this country imported 14,500,000 pounds of ground sumac invoiced at $300,000. Nearly all of this was Sicilian sumac, which contains about 28 per cent tannin. The Sicilian harvest of this material has decreased from 60,000 tons at one time to half that amount at present. Sumac tannin is valuable for making fine leathers for gloves and for boot bindings. It is also used for the re-tanning and currying of heavy leathers. Another important use of the extract is the mordanting of the basic aniline dyes which require a preliminary fixing bath, especially for fixing methyl or methyline green shades in cotton fiber.



Refuse burner of large saw mill, consuming much possible tannin-producing material

There is an almost unlimited supply of sumac in this country, but it is not prized as highly for tanning or for dyeing as the Sicilian product, owing to the much darker color. It comes mostly from Virginia and surrounding country where the two principal species, the smooth sumac (*Rhus glabra*) and the staghorn (*Rhus hirta*), attain their best development. Both of these also grow plentifully farther north but the tannin content of the northern-grown material is lower. Only the leaves and long leaf-stalks are of value, the berries and old shoots being worthless. The leaves are gathered when there is no dew or other moisture on them, wilted for a few hours in the open, and then dried in an open shed until the stems will snap off short in the fingers. They are then packed in burlap bags and shipped to market. The price of native sumac varies from 90 cents to a dollar per hundred pounds in carload lots at shipping point.

Palmetto extract is obtained from the roots of the cabbage palmetto (*Sabal palmetto*) which is very common on the sandy soils of the coast region of southeastern United States. It makes a good substitute for gambier, is useful as a mordant in dyeing, and according to Dumesny and Noyer (Wood Products: Distillates and Extracts, London, 1908, page 278) "no other tannin agent is so well adapted for use in conjunction with chrome as palmetto extract." The authors speak very highly of the extract, for which they anticipate a great future, and give full instructions for its proper use. Palmetto extract is little used at present, though there are indications that the industry will be revived and extended. When first introduced a great many difficulties combined to discourage its use, but it is claimed that these have since been entirely overcome as a result of laboratory researches and factory experience. Canaigre is the name for the tuberous root of a species of *Rumex* growing in the Southwest where it was at one time more or less extensively cultivated. Canaigre contains upward of 30 per cent of tannin. The plant grows prolifically and the yield per acre under favorable conditions is high. About 15 years ago it appeared



Corded chestnut (for acid and pulp) Old Fort, N. C.

that the industry would develop to enormous proportions, but the freight charges for bringing the sliced, dried roots from Texas and New Mexico to the tanners in the East were too high to allow a profit to the producers. It is believed that this industry will be developed later.

Oak bark has always held the highest place among our tannin substances, and, in spite of its growing scarcity and the increasing use of other materials, it still holds supremacy in the manufacture of the best grades of leather. The bulk comes from two species, the chestnut or rock oak (*Quercus prinus*) of the East and the tanbark oak (*Quercus densiflora*) of the West. The tannin content of chestnut oak bark averages between 6 and 8 per cent, while that of tanbark oak runs as high as 29 per cent in some cases, with an average two to three times that of the Eastern species. There are in the South a number of oaks not now used for tannin which may offer possibilities for the future. The tannin content of the bark of any of these species is high enough to be of commercial importance provided the raw material can be had in sufficient quantities. The following table gives the results of some analyses showing the percentages based upon dry weights:

	Black jack *Q. marilandica*	Texan oak *Q. texana*	Black oak *Q. velutina*	White oak *Q. alba*	Spanish oak *Q. digitata*	Post oak *Q. minor*
Per cent total solids..	18.00	14.52	26.46	17.53	20.27	19.41
Per cent soluble solids	17.23	13.37	22.81	16.37	18.68	18.43
Per cent insolubles....	.77	1.15	1.65	1.16	1.59	.98
Per cent non-tannins .	6.51	7.44	9.36	7.09	7.62	8.05
Per cent tannin.....	10.73	5.93	13.45	9.28	11.06	10.38

The bark of the black or yellow oak (*Quercus velutina*) is now employed to some extent in the manufacture of what is known as quercitron bark extract. The bark is steeped in hot water and the aqueous extract is concentrated in vacuum evaporating apparatus. It is used for the dyeing of cotton, silk, wool and fur; for the making of wall-paper lakes, printing inks, and boiler compounds; and for tanning preliminary to dyeing. In 1914, about 12,000 tons of

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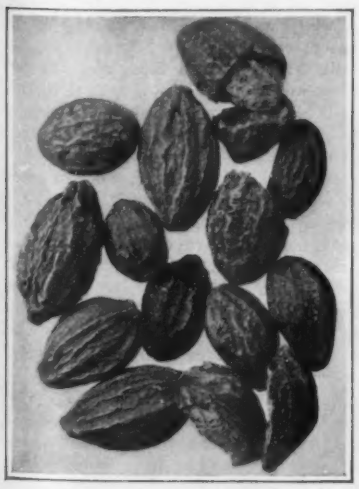
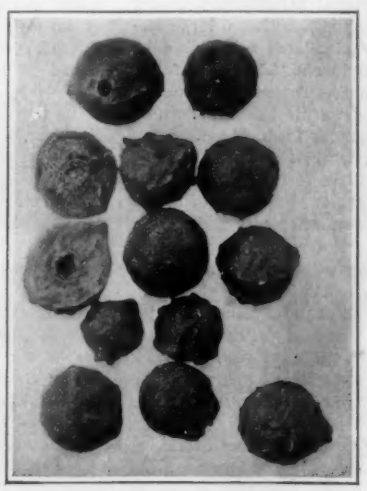
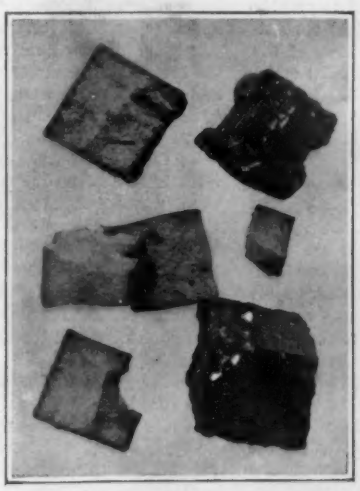


Myrobolan nuts, natural size



Aleppo galls, natural size



Gambier: dried extract from Singapore

Divi-divi seed pods, natural size

Government Transportation Plans

Great Work of the Society of Automobile Engineers in Standardizing Parts

By Coker F. Clarkson

It is scarcely possible to overestimate the practical value to the automobile industry of the standardization of parts which is being carried on by the Society of Automobile Engineers through its Conference Committee on Standard Specifications for Military Trucks. The following article is by Mr. Coker F. Clarkson, Secretary and General Manager of the S. A. E. and Chairman of the above-named Conference Committee.—EDITOR.

IN the great general plan for creating a sufficient national defense for the Government and people of the United States which is so rapidly seizing upon the common sense of the nation, there will be encountered no more difficult or important problems than those having to do with the transport of troops in time of war. This broad question of transportation no longer means merely the passage of armies and supplies over railroads, but has to do with one of the most interesting and vital elements of modern warfare —the motor transport. Precisely as General Joffre is on high authority now believed to have saved the day for the Allies at the battle of Marne by his marvelously swift movement of a quarter of a million soldiers to the front from Paris in taxicabs and motor cars of every description, so here in the United States, with its infinitely greater area, does the automobile, as a speedy, flexible and sure agency of transportation, become a cardinal factor in all considerations of the national defense.

The Society of Automobile Engineers has grown to be recognized both here and abroad as the best expression of the mechanical and inventive genius of the vast American automobile industry. The work which this organization has done in standardizing materials used in this remarkable industry has in many cases been incorporated into international engineering practice, and it is now probable that the work will form the basis of establishing standard specifications for the purposes of the United States Army, particularly in the use of military trucks.

Toward this latter end representatives of the Society of Automobile Engineers have been closely in touch for the past few weeks with members of the War College in Washington, with prominent railroad presidents, representing the American Railway Association, and with the Industrial Preparedness Committee of the Naval Consulting Board of the United States. It now seems reasonable to state that out of this series of conferences the way has been paved to set on foot a closely knit workable organization for the handling of government transportation problems in time of war. The development of the plans has been greatly assisted by the Board of Directors and the General Manager of the National Automobile Chamber of Commerce, which has authorized its executives to meet the military authorities at every point in the building up of an adequate national motor transport service. This important organization has placed at the disposal of the government complete and accurate information concerning the manufacture and shipment of motor vehicles, together with records of dealers' organizations and up-to-date lists of trucks and pleasure car owners in all sections of the country. The American Automobile Association, with organizations in practically every state, is the national body of owners of pleasure cars, and through it will be made possible the coördination of the volunteer movements which are being started in various parts of the United States.

For years the War College has been working on transportation plans to be effective in the event of war. The purpose of the recent conferences in Washington and New York with automobile and railroad representatives was to formulate a complete line of procedure as soon as possible. There were clearly set forth the limitations of the present provisions of the United States statutes and there was discussed such legislation now contemplated as that proposed to be enacted in the form of the Chamberlain Bill to provide for a motor truck reserve corps, the President appointing reserve corps officers subject to the orders of the War Department at any time in case of special emergency and for relatively short intervals in times of peace. It is thought that the motor truck corps will be under the jurisdiction of the Quartermaster's Department and the railroad transportation plans under the direction of the Engineer Corps of the Army.

It should, of course, be borne in mind that modern mobilization plans must be extremely elastic. The great war has taught that. No foreign nation has yet wholly abandoned animal transportation. In mobilization regulations current abroad at this time motor transport is divided broadly into two classes, consisting of heavy trucks and light trucks, respectively. By the use of 2,500 trucks 50,000 troops have been moved in what would have been thought, in past years, an incredibly short time.

The most recent meeting in connection with this movement, which very possibly may revolutionize the great scheme of transportation in this country, at least in time of war, marks the beginning of the establishment of comprehensive S.A.E. military standards. Once the fundamental requirements for the service in mind become clear, any additional detail recommendations necessary can be formulated with due promptness. The work is of a very broad nature, and must obviously be conducted carefully. The extremely hard conditions under which trucks operate at the front in time of war constitute a large study in themselves. The different divisions of the Standards Committee of the Society of Automobile Engineers will be assigned by the Society Council subjects within their jurisdiction and the scope of work extended as shall permit most thorough and effective deliberation.

President Russell Huff of the S.A.E. expressed the view that in addition to the work of formulating ultimate standards the Society should, through what might be called exigent committee work, give all possible advice on specifications submitted to it. Accordingly, a committee was appointed recently to take up with the government officials detail data considered pertinent to standard specifications for gasoline motor trucks of 1½ tons capacity.

The automobile industry will appoint representatives to work on a national plan of military transport to be developed in detail. Ways and means must be had to form units of procurable machines and material. The automobile industry will in the last analysis have to supply the men to man the trucks as well as the trucks themselves. The number of trucks needed would depend on the length of haul rather than the number of men or the amount of supplies to be hauled. It is estimated that there is nearly 30 per cent saving operating trucks 30 miles a day as compared with horse haulage.

The good roads authorities are hopeful that with the existing methods of State aid in forty different states, and the proposed Federal aid, there will be in a short time four or five roads across the United States in an east and west direction, and the same number north and south.

There is good assurance that an adequate military transportation system will be established and maintained in this country, inasmuch as the government officials and the civilian authorities are working sincerely with due strenuousness and effectiveness to this end.

It may be interesting to readers of the SCIENTIFIC AMERICAN to know something of the work of the scientific society which has been called upon by the Government for its advice and action. The Society of Automobile Engineers is now one of the great engineering bodies of the world. Its work is never concerned with yesterday, but rather with to-morrow and the day after to-morrow, and its work is never ended. The automobile industry is developing so rapidly that constant investigation and research work are necessary not only to keep pace with it, but to stay almost in advance of the automobile building art.

The public is always more interested in accomplishment than in promise. A recent investigation among automobile manufacturers has shown that a large majority are using extensively standards established by the Society of Automobile Engineers. The S.A.E. screw and bolt standard, which has been specially developed to meet the needs of the automobile industry, is used by 94 per cent of the companies from whom reports were received. S.A.E. lock washers, consisting of 35 sizes instead of 300 or 400 sizes formerly used before the day of S.A.E., are now standard practice of 90 per cent of those from whom information was had.

Recent standards, the result of painstaking labor by the many different Divisions of the great Standards Committee of the Society, officially adopted by the organization as a whole and made available to the entire motor car industry, include a provision for the elimination of headlight glare, specifications for electric cable for gasoline automobiles, mileage and speed ratings for electric trucks, specifications for steel covering manufacture, purchase and methods of making chemical analysis and physical tests, standard sizes of license plates, standard location of engine and chassis numbers, rubber hose and hose fittings, and methods of testing leaf springs.

But the lay reader—the man in the motor car—may ask wherein does all this profit him. The answer is very simple: through the steady reduction in price of cars accompanied by an equally steady increase in quality.

Even the manufacturers of engines for agricultural tractors are using S.A.E. standards as a basis for specifications. Thus in the future farmers of the country will benefit by work begun by the automobile engineers. Organizations of motor boat and aeroplane engineers are also planning to use S.A.E. standards as a foundation in their own standardization work; and the older organization is giving every assistance to these younger bodies.

As evidence of the quality of the personnel of the Society of Automobile Engineers it is interesting to note that three of its past-presidents have recently been called upon by the Government of the United States for the use of their talents. A. L. Riker is an active member of the Naval Consulting Board of the United States; Howard E. Coffin is Chairman of the now famous Committee on Industrial Preparedness of that Board, and Henry Souther, who in addition to being a past-president was for several years Chairman of the Standards Committee which has done so much to bring the American automobile industry to its present development, has just been appointed by Secretary of War Baker, consulting engineer to the United States Aviation Corps, to aid in the development of that branch of the armed forces of the Government.

The keen interest of the automobile engineer in the construction of the economically operated automobile is shown by the nature of recent meetings held by the local organizations, or sections, of the society. For example the Metropolitan Section held a largely attended meeting in New York at which the automobile fuel situation was considered in all its phases. The Cleveland Section of the society at its April meeting discussed recent developments in carburetion that are expected to have an important bearing in reducing fuel consumption and in permitting the use of cheaper fuels than are at present possible. The Indiana Section held a most enthusiastic meeting lately at which an entirely new method was described of converting the heat of the fuel into useful work.

These local meetings and the establishment of widely used standards are an expression of the value of the society's work both to the public and to its members. The society is continuously growing because it meets the demand for a coördinate body of the automobile industry, wherein technical matters can be authoritatively discussed, preferable engineering practice recommended, and friendship and fellowship fostered. The coöperation and interchange of knowledge resulting from the activities of the society benefit its members directly and through them everyone interested in any way, as user, dealer or maker, in the automobile industry.

Thus it will be seen that while the Society of Automobile Engineers owes its existence to the scientific and mechanical needs of the fourth American industry in point of size, its activities and achievements are in no sense solely academic and technical, but in their broad scope touch the life of the nation at many points.

Sewer Pipes from Hawaiian Molten Lava

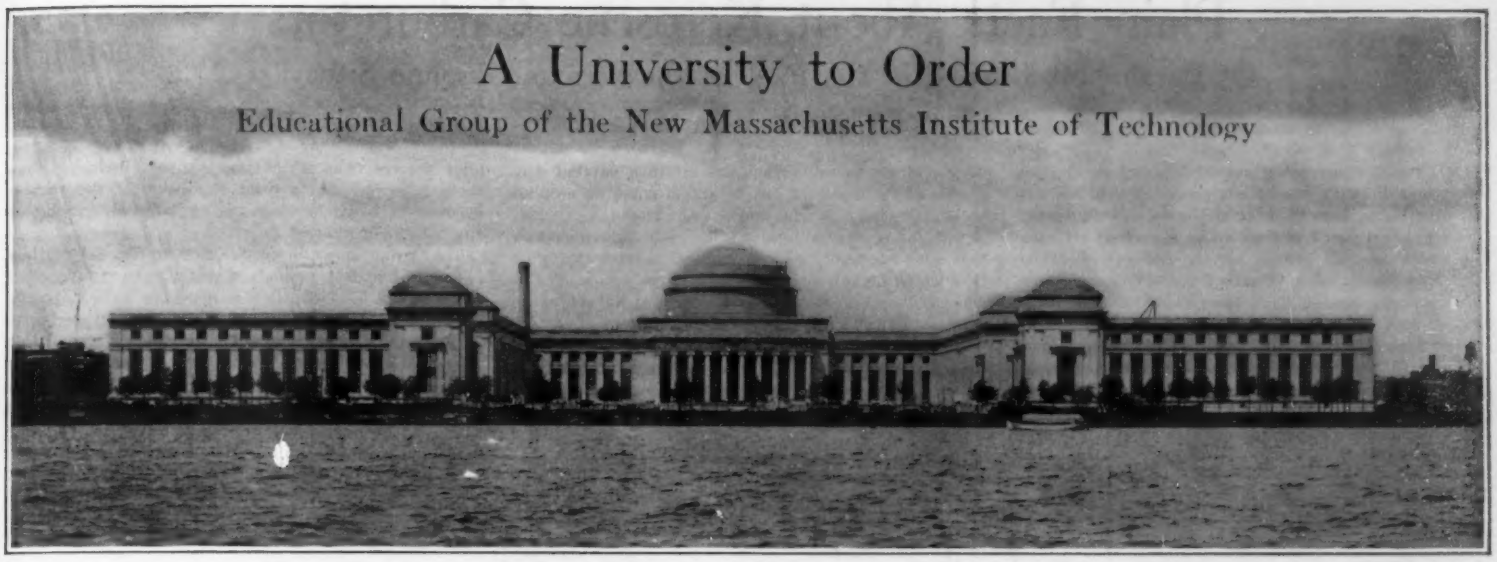
THE making of sewer pipes and bricks of the molten lava from the active volcano Kilauea is advanced as a business proposition by a retired Ohio manufacturer of sewer pipes, who visited the Hawaiian Islands in February of the current year. The volcano is on the island of Hawaii, 32 miles from Hilo, and reached directly by automobile over a smooth road that dips down through a break in the wall of the old crater to the floor of dead lava and thence almost to the brink of the pit of Halemaumau.

It is declared that with proper machinery, pipes could be molded from the molten material in foundries. The plan has been advanced to erect endless bucket conveyors that could bear the lava out of the pit, the buckets to be made of a special material capable of withstanding heat up to 2,000 deg. Fahr. It is believed that the lava would remain liquid during the short time it would be on the way to the molds, which could be placed in a building near the edge of the crater.

For the past ten years a local brick company has been making building bricks from lava rocks. Its plant is located in the district of Kaimuki, where there is a vast outcropping of lava rocks from ancient flows. These bricks are gray in color and have been used extensively in the construction of buildings and particularly in sewer, manhole, and fireplace work.

A University to Order

Educational Group of the New Massachusetts Institute of Technology



Front of new Massachusetts Institute of Technology Building, seen across Charles River from Boston

WE are accustomed to beholding in the mere physical aspect of a university—in its grounds and buildings—the evidences of small beginnings, of growth and development, of slow enlargement, addition and extension. On the typical campus the old mingles with the new; the first building put up by the original founders rubs elbows with the gift of the latest Decennial class; a few structures are still found adequate for their original purposes, others have been directed to entirely different ends. In keeping its physical equipment in harmony with its changing scientific aims—with the changing aims of science itself, in fact—the University finds makeshift and compromise a vital necessity. Three Schools of diminishing consequence are housed together in a building designed for one of them, and the School of the hour sprawls itself all over the campus, seizing on vacant buildings and floors and rooms where it can find them.

A new University, however richly endowed and elaborately planned, cannot have the complete and well balanced scientific organization developed by years of experience. An old one, on the other hand, is of necessity confronted by this problem of physical adjustment. The obvious middle ground is to take an old University and put it in new clothes; to let it outgrow its old physical body entirely and get a new one. It has remained for the Massachusetts Institute of Technology, of Boston, to furnish the supreme example of a University thus made to order.

For years this institution has been badly crowded in its old home in Boston; and the impossibility of getting land for expansion led to a solution of the problem by transplanting the entire University to a new site, across the river in Cambridge. The plans call for a complete home, with residential halls and a social center, as well as facilities for conducting studies, but the Educational Group is the first and by far the largest step towards realizing the dreams of the thousands of friends and alumni of this famous institution of learning. The New Technology will be dedicated with the completion of this group on June 12-14, after nearly two years and a half of construction, and a host of alumni, many of them national figures in business and the sciences, with invited guests prominent in all walks, will attend a great three-days' celebration on the beautiful site facing the Charles River Basin, Boston's unique water park.

There are twelve connected buildings in this Educational Group arranged along three sides of a broad and deep central court flanked by two side courts of only less magnitude. Around these courts are ranged the class-rooms, lecture rooms and laboratories. Few structures built for any purpose exceed this group in magnitude of constructional work. Six thousand carloads of material were handled, which would make a train reaching from New York to Albany—a distance of 150 miles. This material was moved by means of a temporary railroad surrounding the buildings and served by locomotive cranes as well as locomotives. The concrete and masonry used totaled 80,000 cubic yards, enough to make a solid shaft the height of the Woolworth Building, with square section, and filling Broadway from curb to curb; and an approximate amount of sand and gravel was employed.

The best part of the work of M. I. T. is done in the laboratories, and these have been planned in the new buildings with the greatest care and attention to detail. The steam laboratory in the Mechanical Engineering Building receives high pressure steam through two mains located below the ceiling of the first floor. A superheater may be connected at will with the machines where experiments are to be made. The condensers of the various engines in the steam laboratory

Hydraulic laboratory, showing 10-ton crane

are in the basement and take cooling water from one of the large canals of the hydraulic equipment, passing the used water into a hot water return. Apparatus for determining the flow of superheated steam through orifices or turbine nozzles will also be located in the basement.

The Institute has conducted a modest aerodynamcl laboratory for many years and for six or eight years has paid special attention to fundamental principles of aircraft construction. The up-to-date aerodynamic equipment of the new buildings includes a 4-foot blowing tunnel, in which velocities may reach 40 miles an hour. A 7-foot fan sucks the air through the tunnel, in the center of which, where the air currents are most regular and steady, are arrangements for placing the various devices to be tested. Perhaps the most novel feature of the equipment is the aerodynamical balance, an instrument for measuring components in any one of three directions. This instrument, of English model, measures wind pressures, the twist due to inequalities of pressure, and the lift, and is adaptable to all kinds of surfaces. Thus the effect of wind on planes may be determined, or on propellers, or even different forms of sails.

The electrical laboratories, maintained by coöperation between Harvard and Massachusetts Institute of Technology, will contain the finest collection of artificial electric conduction lines in the world. There will be a 2,000 nautical mile artificial submarine cable, corresponding to a regular ocean telegraphic cable, a 2,500 mile, long distance, aerial line corresponding to a transcontinental telephone line, two artificial power transmission lines of 800 miles, an artificial telephone subterranean line of 35 miles, and a number of other special transmission lines of unusual types. In addition to these, there is a transmission span, the gift of Stone & Webster, a replica of the Big Creek 150,000 volt power transmission line in California. This has been in place for a year or more and is used for testing in a variety of ways, such as the effect on sag of temperature and the relations of soil surface to electrical ground for which there are no formulæ existing. For these tests a local laboratory has been installed at the foot of one of the towers. Experiments are also conducted, using the wires of the span or antennæ.

The design of the hydraulic laboratory, containing some 700 feet of waterway, has received study from many prominent hydraulic engineers, and is constructed throughout with a view to enabling the most precise experiments in flowage and hydraulic work. Water is supplied from the concrete intake connecting with the Charles River Basin, and flows into large circulating canals in the basement of the building, from which it is pumped through a venturi tube into an open steel flume located on the second floor. From this flume it flows through a steel penstock provided with openings for water wheels. A concrete draft tube connects with the lower end of the penstock, and from this draft tube the water discharges through sluice gates or over weirs back into the circulating canal. The capacity of the system, including the circulating canals and the adjoining steam laboratory, is 250,000 gallons.

The equipment includes many pumps and tanks. A belt-driven rotary pump of a thousand gallons a minute capacity will be used in connection with a steel pressure tank, 5 feet in diameter and 32 feet high, built for a pressure of 250 pounds to the inch. An artificial head of 575 feet is established in this device by means of compressed air forced into the top of the tank. Flow through orifices is always an important part of hydraulic study, and this is naturally affected by any currents within the tank that come near the ori-

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Looking across the unfinished campus toward Boston

Plain Facts About Kerosene Carburetors

Of Paramount Interest in the Face of the Serious Gasoline Situation

By Victor W. Pagé, M.S.A.E.

THE rapidly increasing use of internal combustion engines in all types of self-propelled vehicles and in motor boats, as well as in the numerous stationary power applications, has resulted in a scarcity of gasoline which has not been a serious factor to consider until this year. As a result of the increasing price, numerous suggestions have been made that kerosene be used as a substitute fuel. A number of devices are offered for vaporizing kerosene, and many claims are made by the promoters for these that are not always thoroughly borne out in practice. While kerosene is fairly plentiful, its physical properties are such as to render it a poor substitute for gasoline with existing carbureters and engine design.

The main drawback is that kerosene is much less volatile than gasoline, and must be raised above atmospheric temperature before it will vaporize readily. This lack of the property of quick evaporation, which has been the greatest advantage of gasoline, not only interferes with rapid volatilization but makes kerosene a "smelly" fuel to handle.

Kerosene, however, has marked advantages which will appeal to the user of internal combustion engines more when entirely suitable devices are evolved for gasifying it successfully. The big advantage at the present time is the relative cheapness, the cost being somewhat less than one half the present wholesale price of gasoline. At the present time the fuel cost of the average small car may be taken as one cent per mile, though if the less volatile fuel could be used the cost would be but 0.4 cent per mile. Owing to the greater number of heat units in kerosene, about 5 per cent increase in power would be secured from the same quantity, though this is conditioned by securing practically complete vaporization. Owing to the lubricating power possessed by kerosene, less lubricating oil will be required. It is very likely that heavier oil will be needed in an engine using kerosene than in one using gasoline on account of the dilution and consequent thinning of the oil in the crank case by the kerosene which will condense from the vapor in the engine cylinders and work down by the piston rings every time the engine is stopped and allowed to become cool. As kerosene carbon is drier and somewhat finer than the residue left after gasoline is burnt, there should be less spark plug trouble and the cylinders can be cleaned easier. If the carburetion of kerosene is successfully accomplished, a slightly greater mileage per unit of measurement will be secured than with gasoline.

Considering at the present time its use in automobile engines because it has been successfully applied in stationary and marine power plants, one great disadvantage is that it is not possible to start the ordinary gasoline engine "cold" with kerosene. Therefore the most successful kerosene carburetors are really bi-fuel, in that gasoline may be used for a preliminary run to warm up the engine and the vaporizing chamber and then turned off and the kerosene vapor allowed to go to the hot engine. Another disadvantage is that the compression of the ordinary gasoline engine must be reduced in order to use kerosene vapor. After the engine has run a while, providing that the compression is over 40 to 45 pounds, a pronounced pounding will result which is due to preignition of the vapor. In order to use the normal compression of 65 to 70 pounds, the cooling system must be greatly increased in efficiency, or water must be injected with the gas charge. Another difficulty is smoky exhaust if the mixture of kerosene and air is not carefully proportioned.

With most kerosene carburetors that the writer has tried—one series of tests made for a prominent metropolitan taxicab company furnished the opportunity of trying a number of the most successful devices—it was very difficult to proportion the mixture so that any degree of flexibility of engine action could be secured without having a grayish smoke issue from the exhaust. This had a disagreeable odor of kerosene, which showed that some excess of fuel was required to have an engine that would be at all responsive to throttle control. In no case where kerosene was used could an engine be throttled down to run as slowly as with gasoline, though with certain carburetor settings it was possible to run the engine as fast, with kerosene, except for a few revolutions beyond the peak of the power curve, as it was with gasoline. The time required to heat up the engine so kerosene can be used must, of course, depend on a number of variables which will differ in every individual design. With carburetors where the exhaust gas heated chamber was of liberal proportions, it was found possible to turn on the kerosene after the engine had been running for several minutes. After the engine had become heated up it was possible to start it on kerosene vapor after it was stopped, without requiring the use of the auxiliary gasoline vaporizer. In one case the automobile engine with which the trials were made was started on kerosene 15 minutes after it had stopped. A stop of greater length than this necessitated the use of a gasoline carburetor or the gasoline section of the kerosene carburetor to secure a reasonably quick start.

It does not seem to the writer that, in the limited space available, any extended review of the characteristics of the various fuels is justified. Data of this kind, which is purely technical in nature, does not as a rule interest the majority of readers; and those who are sufficiently versed technically to feel the need of this information have many authoritative and readily accessible sources from which they can obtain it. It does seem, however, that a brief exposition of the various systems of using kerosene as an internal combustion fuel will be of interest.

The engine shown in part section at Fig. 1-A outlines one of the earliest methods of using kerosene and other oils that are less volatile than gasoline. The engine is a two-stroke form and is an unconventional design in some respects. This type of construction is not suitable for engines that are to attain high speed or be of light weight, but was intended primarily for stationary power plants designed to run at a constant speed. Ignition was by a heated bulb which forms a continuation of the combustion chamber. The fuel is injected into the hot cylinder head through a special fitting, just before the piston reaches the top of its stroke, and as the fuel strikes th hot vaporizing spoon which projects into the combustion chamber it is vaporized because of the intense heat of the relatively thin metal section of that part. The portion of the vapor forced into the ignition bulb just before the piston reaches the end of its up stroke is ignited because of the heat of that part. The resulting combustion ignites the remainder of the charge and exerts the desired pressure on the piston top. The kerosene is injected by the pressure produced by a small oil pump of the plunger type. To start the engine, heat is applied to the ignition bulb by means of a gasoline or alcohol torch.

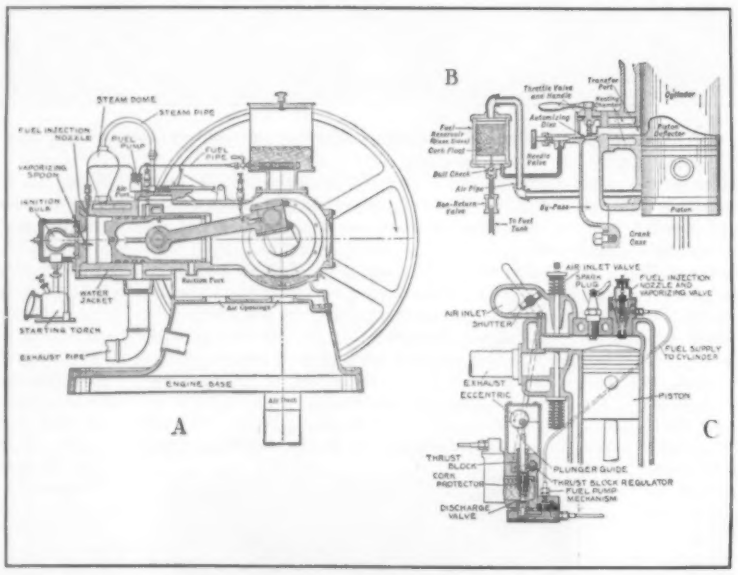

Fig. 1.—Forms of engines designed to use kerosene fuel by injecting it into the cylinder under pressure

In view of the present often-repeated suggestions that water vapor be used to assist in securing proper combustion of the kerosene vapor, it is interesting to see that this feature was recognized on the type of engine illustrated which was designed fully 20 years ago. A steam dome was attached to the water jacket, and as the cooling water became hot enough to evolve steam, this collected in the dome and was forced into the air port where the moisture mixed with the air stream coming from the crank case and passed through the air port into the cylinder.

A more recently devised scheme for injecting kerosene vapor into a two-stroke engine is shown at Fig. 1-B. This system has been used on small marine motors, as well as stationary farm engines. With this device the liquid is converted into a fine mist before it enters the cylinder. A fuel reservoir, carrying a cork float, is connected to the main fuel tank with one of the pipes at the bottom and with the needle valve of the atomizer by the other small pipe. A larger pipe connects the top of the fuel reservoir with a small port in the cylinder walls just above the by-pass leading from the crank case to the atomizer device. The chamber leading to the cylinder is surrounded by the water jacket which keeps the short passage leading from the atomizer to the transfer port hot. Carburetion is effected by a combination of mechanical atomization and the vaporizing influence of heat. The engine operates on the well-known two-stroke principle. Just before the transfer port is opened by the piston on its downward stroke the air pressure in the crank case passes through the air pipe and against the top of the float chamber, producing a pressure therein which forces the liquid fuel through the opening in the seat of the atomizing disk. This disk is lifted by the air flow from the crank case when the piston uncovers the transfer port. This air has been drawn into the crank-case through a suitable valve in the engine base which opened when the piston was on its up-stroke. The air stream rushing past the atomizing disk picks up the fuel vapor forced in from the reservoir and as this mixture of air and vapor is directed to the top of the cylinder it must pass the heated deflector member at the top of the piston. This produces practical evaporation of the kerosene mist and the resulting gas is easily ignited by the usual form of spark plug. Inasmuch as

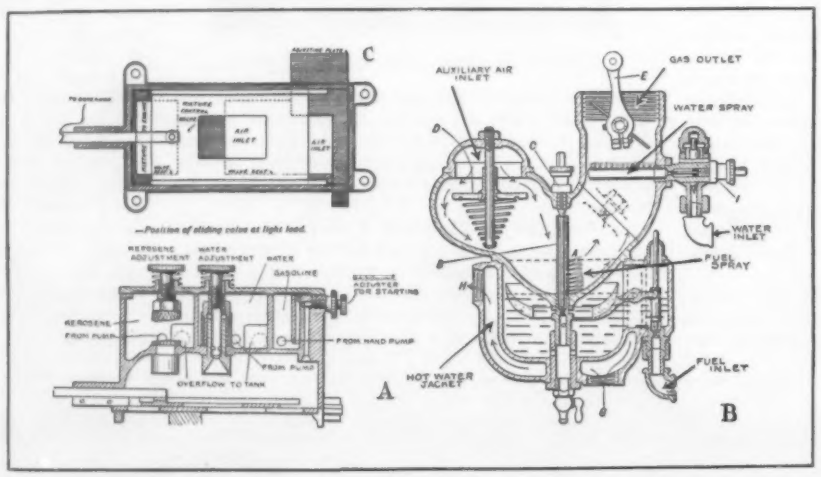

Fig. 2.—Kerosene vaporizers in which water spray is mixed with gas

a certain amount of time is needed to secure thorough vaporization, it is not possible to run this engine at a high rate of speed though some degree of speed control is secured by the throttle valve mounted just above the atomizing disk which controls the area of the by-pass.

The engine shown at Fig. 1-C is a four-stroke design of French derivation and is known as the Bellem and Brégéras. This has been devised especially for automobile use, and one of its characteristics is that it can use, without preheating, the less volatile fuels and can start cold on ordinary kerosene. In order to secure this important feature the inventors inject and atomize the fuel under very strong suction. At each induction stroke a definite amount of liquid is carried by a pump into a special atomizing valve which opens only after the piston has accomplished a certain part of its induction stroke, thus creating a considerable vacuum inside the cylinder. Immediately after this carbureted air is admitted, the remainder of the cylinder volume is filled with pure air through a second admission valve.

Speed regulation is obtained by a variable speed feed pump. This is a reciprocating type of the usual plunger construction in which that member is worked by a connecting rod and eccentric. The cylinder is not fixed to any part but is centered about the piston in the usual manner. No packing glands are employed but a cork protector which produces considerable friction between the cylinder and piston is used instead. If the cylinder were not limited in its movement it would move up and down with the piston without any pumping action resulting. Two thrust blocks limit the motion of the cylinder which movement must be deducted from the effective stroke of the pump. By varying the distance between the thrust blocks one can alter the difference in motion between the cylinder and plunger and of course regulate the effective stroke and output of the fuel pump. The regulation of speed is effected by changing the distance between the thrust blocks. A throttle in the air pipe through which air is admitted on the suction stroke is interconnected with a regulating device which governs the upper thrust block. The pump takes in air at the bottom of its stroke and the fuel delivery occurs when a valve is lifted off its seat by the cylinder. It will be apparent that a rather complicated injection nozzle or vaporizing valve must be used in the cylinder head and that the oil pump mechanism is not free from complication either. The resulting number of small parts which are likely to get out of order will not be welcomed by the average motorist. It does not seem that a system of this nature could be used successfully by the average automobile operator because of its complication.

Owing to the large size of tractor engines, the power plants of a number of agricultural tractors are arranged so that kerosene, distillate and similar low grade oils may be burned successfully. The device shown at *A*, Fig. 2, is the carburetor which operates on what is known as the Secor-Higgins system. This is not a new method by any means because it was developed over 15 years ago. The device provides an automatic variation in the quantity of fuel mixture in accordance with the variation in speed and load of the engine, in conjunction with a degree of compression depending upon the quantity of mixture inhaled. The main feature is the automatic control of the internal temperature through the admission of water as part of the fuel mixture. It is claimed that controlling the temperature of vaporization and combustion in this manner means that there is no "cracking" of the low grade oil, with its attendant carbon deposit. The injection of water also permits the use of higher compression and reduces the pounding which is found in many kerosene engines. It is also said to give an increase in power of 10 to 15 per cent over a similar engine and carbureter operating without it.

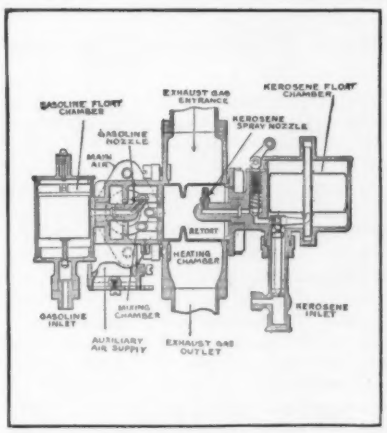

Fig. 3.—Early form of bi-fuel carburetor

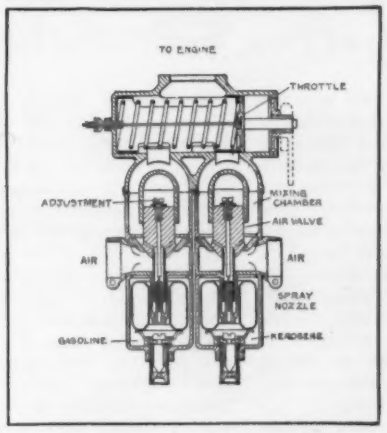

Fig. 4.—The Belsize bi-fuel carburetor

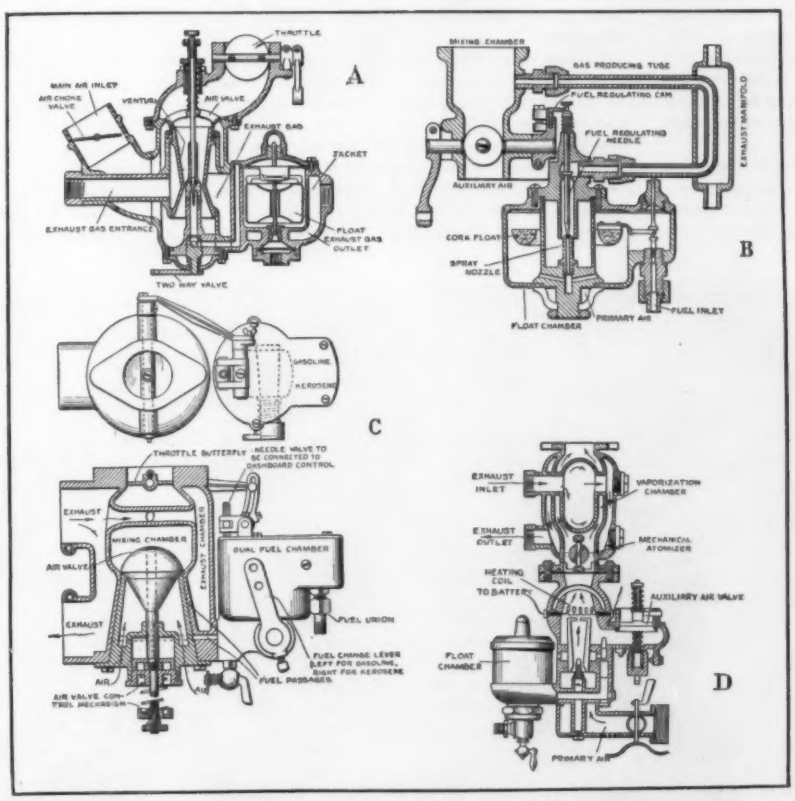

Fig. 5.—Group of kerosene carburetors in which the mixing chamber is heated to vaporize the fuel and raise the temperature of the gas and air mixture

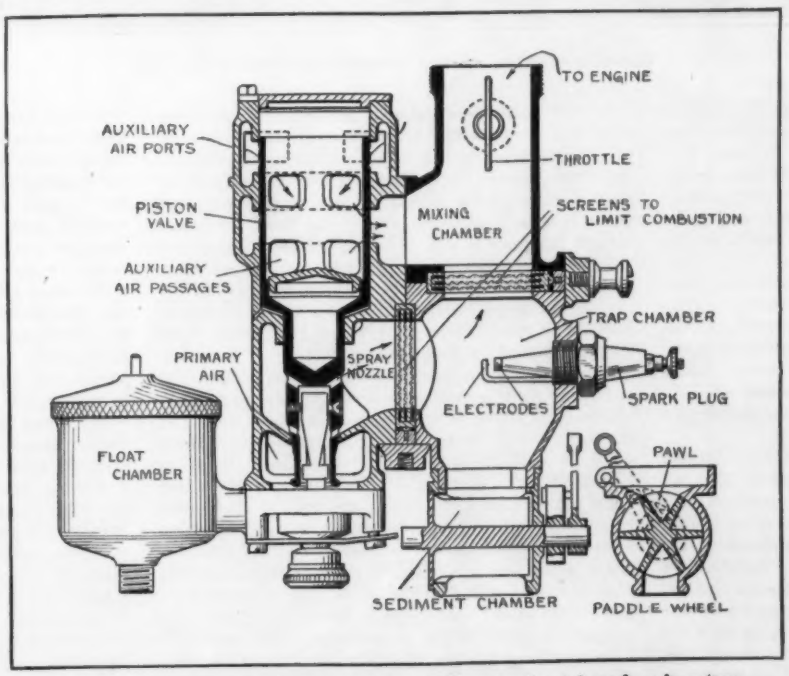

Fig. 6.—Kerosene carburetor in which a partial combustion takes place in a trap chamber to secure vaporization of the fuel

The feature of the device is that the water is not only controlled in amount but is taken into the engine automatically. As the load increases the throttle opens because of the governor action, and more air is inspired through the carburetor. It is not until about half load is reached that the suction becomes strong enough to lift the water, hence it is not present to hinder ignition at light load. The special carburetor which makes possible the application of this system is clearly illustrated. A flyball governor (not shown) operates a sliding brass valve, known as the mixture control valve and clearly outlined. The carburetor is placed above the cylinders, having a very short inlet manifold so there is little opportunity for the liquid to condense from the mixture on its way to the combustion chamber. The device contains constant level chambers for kerosene and water, both chambers being supplied by power pumps and having overflows to return the excess to the tank. A similar chamber which may be filled with a hand pump is used to hold gasoline for starting. The kerosene supply is regulated by a needle valve and a similar method of regulation is provided for the water and the gasoline. An air inlet is regulated by an adjusting plate and the only moving part in the carburetor is the sliding plate worked by the speed governor. The adjusting plate is to permit of the carburetor being adjusted to the specific engine it is to serve and this need not be changed unless the engine enters a different altitude. While this device works out very well on tractor engines it does not permit the variation in speed or the quick "pick-up" that is so essential in automobile engine operation.

The carburetor shown at Fig. 2-B is a conventional float feed type designed to use kerosene vapor. This also has water spray injection with the mixture in order to secure thorough combustion. It will be noticed that the float bowl is provided with a jacket through which hot water circulates. This heats the kerosene and makes it vaporize more readily. The operation of this device does not differ from the conventional gasoline carburetors as it is very similar in construction, except for the interposition of the water spray in the mixing chamber. This type of carburetor provides for thorough atomization by drawing the fuel through small holes in the standpipe, as the suction increases the fuel rises higher in the standpipe and is drawn through a greater number of holes. The auxiliary air valve is of the flat seated type and is normally held seated by a coil spring. As is true of gasoline carburetors, the spring tension may be altered to regulate air valve movement. The kerosene spray nozzle is regulated by a needle valve as is also true of the water supply. With the device shown an independent gasoline atomizer is needed to start the engine, though this is shut off as soon as the engine becomes hot enough to operate on kerosene.

It was but natural for early inventors who sought to use kerosene to evolve a type of carburetor that was really a dual instrument and that was provided with independent gasoline and kerosene float chambers. The device shown at Fig. 3 was invented fully 15 years ago and is known as the Claudel carburetor. It will be observed that there is a gasoline float chamber on one side and

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Our New Industries

Some of the Fields Into Which American Manufacturers Have Been Forced

By Dr. Edward Ewing Pratt, Chief of the Bureau of Foreign and Domestic Commerce

EVERY American, I suppose, is familiar with the fact that the war has had a tremendous influence on our industrial life, and of the factors that go to make up our present material prosperity the most evident are undoubtedly the sudden expansion of the iron and steel industry, the giant strides made in the manufacture of munitions, and the record crops of cereals and the high prices paid for them. Some lines have benefited from war-zone demands, while others have benefited from the war-zone's inability to supply American demands. This article is concerned with the latter—with the new industries that have sprung up to supply goods that were formerly supplied by Europe and the old industries that have been greatly expanded to meet the demands for such goods.

These new industries have resulted either because certain lines of goods formerly received from the Central Powers and Belgium have been cut off altogether or because accustomed supplies from the allied countries have been greatly reduced by the lack of ships. In either case Americans are learning to manufacture goods that were formerly bought abroad, and this experience will undoubtedly, in the long run, be of more real benefit to the country than the temporary munitions business.

Our principal purchases from Germany, in the order of their value, have been hides and furs, cotton manufactures, dyes and chemicals, machinery and other manufactures of iron and steel, potash, pottery, silk and silk manufactures, toys, glacé leather and glacé-leather gloves, rubber, paper and paper manufactures, and salt. Of these classes there are several of which Germany has had a practical monopoly — such as dyes and certain chemicals, potash, and toys—and the effect of cutting off some of these was immediate and serious. The principal problems we have now before us are the more complete utilization of the coal tar obtained in the coking industry and a method of manufacturing potash from one or more of our potash-bearing materials.

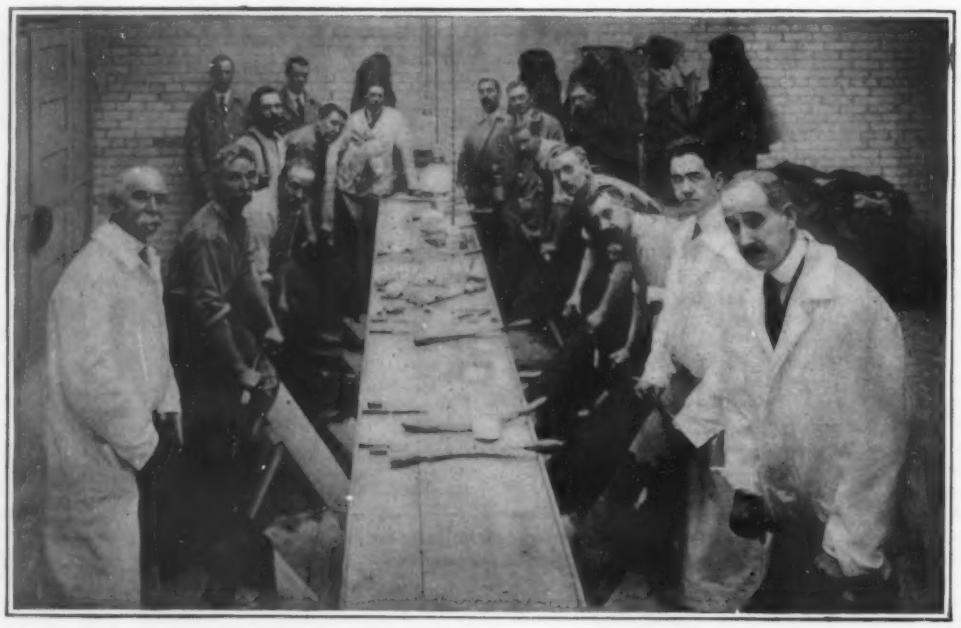
Necessity has forced us to make rapid progress in the chemistry of coal tars, and although the demands of the munitions manufacturers have interfered with the development of the dyestuff industry and the many minor branches that depend upon coal tar, the progress made by our dye makers has exceeded the expectations of all well-informed persons. The recovery of coal-tar "crudes" from the coke-oven by-products has now been so developed that the output is more than sufficient to cover the needs of a national color industry. Two years ago the annual output of "crudes," i.e., benzol, toluol, naphthaline and phenol, was about 14,375 tons. To-day the estimated output is at the rate of 135,000 tons a year.

Some 33 companies are now occupied with the manufacture of coal-tar intermediates. The leading production is aniline, of which the output for 1916 will exceed 15,000 tons. Over 3,000 tons of the other intermediates are produced by the same companies. Large additional amounts are made in the works of companies directly engaged in manufacturing colors and making their own intermediates.

The number of companies manufacturing finished dyes has increased from 6 in 1914 to 24 in 1916, although it should be borne in mind that some of these are small companies devoted largely to experimental work. Finished dyes are now being produced at the rate of 15,000 tons annually. Increased facilities for producing direct blacks and sulphur blacks are responsible in large measure for this expansion of our dyestuff industry, as it has been necessary to meet the most pressing needs of color users first. There has, however, been a regular production of other colors, especially of blues, and steps are being taken to increase the extent and variety of this output.

Moreover, the growth of the natural dyestuff industry as a result of the color shortage has been very interesting. The Bureau of Census reports a domestic output of such dyes of $1,866,000 in 1914, an increase of 32 per cent as compared to 1909. At the start of the war American extract works were fortunately in a position to expand rapidly and were handicapped only by the difficulty in getting raw material from the West Indies and elsewhere as quickly as it was wanted. The principal increase has been in logwood extract, quercitron, fustic, cutch and archil. At the same time the production of osage-orange extract on a commercial scale has been established, and this material is now available for the tanning, textile, paper, and other industries. It is being used successfully in dyeing paper. The study of osage-orange as a dyewood was begun by the United States Forest Service about three and a half years ago, and was the result of an investigation of the utilization of the mill waste of this western wood.

It is not at all likely that natural dyestuffs will ever again be discarded to the extent they had been before the war started. They have certain distinct advantages that will not be forgotten, and the dyers have been able to produce a number of combinations effectively and economically with the natural materials. The present situation has rendered a valuable service in bringing home to our manufacturers the value of natural dyestuffs and in broadening the dyer's trade.



Unhairing sealskins. A new industry established in St. Louis

Carbolic acid is a coal-tar product that formerly came almost exclusively from Germany, and it was one of the products that we could not get along without. American ingenuity soon found a way to make it, as most readers of the SCIENTIFIC AMERICAN know, and there is now a sufficient supply for most needs, although the price is still high. If we are to work out a satisfactory system of using our coal tar we must give considerable attention to carbolic acid. With the greatly increased production of coal tar it should be possible to manufacture it at a cost that would make foreign competition impossible.

There are a great many other derivatives of coal tar that were made almost exclusively in Germany before the war and which we shall have to manufacture if our coal-tar industry is to be a well-balanced one. Many of these derivatives are used medicinally, such as acetanilid and aspirin, and have been greatly missed since the war started. Others are used as developers in photography, and only recently a warning has been issued that these should be used as sparingly as possible. Some progress has been made in manufacturing hydroquinone, probably the most popular developer, and other coal-tar photographic chemicals at home, and with the incentive of the present high prices there will be a continued increase in production during the coming year. Salicylic acid will soon be made in large quantities in works going up near New York. Saccharin is another German coal-tar product now being made here in small quantities, although the price is up about 600 per cent. Coal-tar creosote, so largely used in preserving lumber, is also being supplied in increased quantities. Even some beechwood creosote is being refined on a small scale by some chemical concerns. Benzoic acid, largely used as a preservative and antiseptic, is being manufactured from toluol.

But the effects of the war upon the coal-tar industry are more or less familiar to every one. The topic has been touched on here only because of its transcending importance. We have been taught the value of the industry, and I hope we will show how much we appreciate the lesson by mastering the difficult problems connected with it and keeping the business here at home. There is no use of minimizing the difficulties that lie in the way of bringing our technical efficiency to the point required to make a success of the coal-tar business. It will take time and it will take painstaking effort, but it can be done. It must be done. We must learn how to utilize all the by-products to the best advantage, and how to find markets for the finished products. The war has expanded our production of coal-tar crudes to supply the demand for explosives, and it is necessary that this factor in preparedness be not lost to us. We must develop the other branches of the industry to keep these plants running during peace.

Next to the coal-tar products, potash is the most important of the articles Germany is no longer able to furnish us. The natural German deposits can be worked so cheaply that in the past there has been very little incentive to recover the material from kelp, alunite, or other sources, but when the supplies from overseas were cut off there began an eager searching of our own resources. Considerable potash has been secured in various parts of the country as a primary product from kelp, alunite, the brine of certain alkaline lakes, tobacco stems, and mica deposits; and as a by-product in the manufacture of Portland cement and distillery waste. But owing to the high prices, most of this has been used in industrial processes rather than on the soil. Potash as a fertilizer is about as scare now as at any time since the war started.

One other American industry has been greatly stimulated by the blockade of German ports—the manufacture of dolls and toys. The rush to get into the toy business when the war broke had some aspects almost as comic as the most comic of the funny toys, and I suppose there are now some sadder and wiser citizens as the result. A number of good solid companies have made a fine start, however, and many of the older companies are established on a scale they never dreamed of before. There is one novelty company in New York occupying all of a five-story building that was not in existence a year ago, and there are dozens of other instances of firms that have grown too large for their old quarters. I have talked to a number of the successful manufacturers, and their opinion seems to be that the most promising field is the manufacture of typical American toys. These are being brought to a high degree of perfection and, even more important, into a high degree of public favor. Once these toys are firmly established it will be difficult to sell Continental toys and dolls in this market again on any large scale. Some success has been achieved also in making imitations of the products formerly purchased abroad, and doubtless some of this business will be retained permanently. I have had called to my attention some of the patents recently asked for on American toys. Some, of course, are preposterous, but a great many excellent ideas have been patented, and this is one of the most hopeful signs in the toy trade. With all our American ingenuity, there should be very little room here in the future

(Concluded on page 600)

War Game—XII

Strategical Plan of a Campaign and Its Tactical Details

By Lieut. Guido von Horvath

[This is the last of the SCIENTIFIC AMERICAN *War Games or map problems. They began with the issue of March 11th, in which a very simple problem was dealt with. Successive numbers have had to do with increasingly complicated movement of troops and now the series is terminated with the strategical plan of a campaign and its tactical details. The articles have been written particularly for laymen. We hope that they have been found profitable and instructive.—* EDITOR.]

THE preceding series has shown and illustrated that to make a War Plan and to work it out in all its details, the enemy must first be considered.

It would be a great mistake to think that a strategical campaign can be planned ahead for its entire course, or that a general staff can develop a plan for an entire war which will contain every development from beginning to end. The Game of War, some features of which have been shown in the problems we have introduced, appears much like a growth, a steadily changing chain of events, where every action influences the next. The plans of a war are the results of an evolution along a predetermined line.

What, then, is meant in speaking of a War Plan?

It is not so much a War Plan as it is a plan to lead the forces of a nation to a successful conclusion of a war. It can be best expressed by a word much in evidence just at present: "Preparedness."

The logic of war is the logic of life in general.

In business, every plan of operations which involves two parties is based upon the same principles upon which war is conducted. In each plan of operations, both in business and in war, the will of one contender is pitted against the other.

The salesman, when he approaches a customer for the first time, in an effort to sell some meritorious product, is in a way a general. It depends upon the strategy and tactics which he employs whether or not a sale is to be made. There are a thousand and one plans for selling goods, plans which have been made by experts in their line, yet, from all these plans, there is not a single plan which will fit every case. One salesman will win his battle by aggressive tactics; another, by a slow, wearing-down strategy; another, by a swift assault against the prospective buyer's weak spot. Still another will win through sheer luck.

These are all features in the game of generalship.

We do not mean to assert that a good salesman would make a good general, any more than that a good general would be successful as a salesman. We mean that in business life as well as in war, success will come to him who is thoroughly prepared in the line of endeavor which he selects.

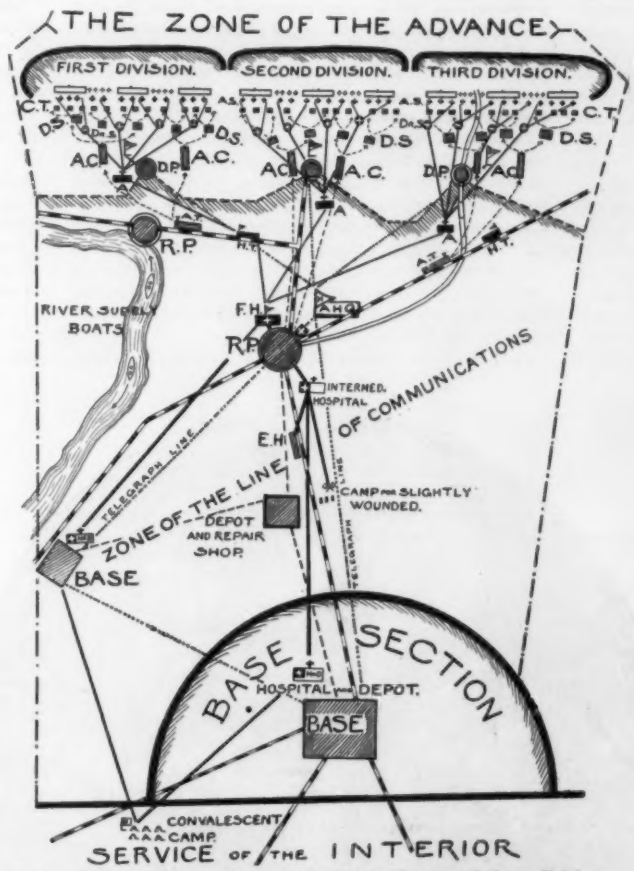
This all means that plans must be prepared, not for the whole campaign, but for its successful beginning. Such plans must be on a large scale. They must provide first of all for the successful mobilization of all forces and war material, and their speedy and well-timed transportation to points of strategical importance.

No one can foretell the outcome of a combat. This is the reason why far-reaching and skillfully planned campaigns would fail, simply because a combat is the unknown quantity in the mathematics of strategy. But, while in the mathematics an exact result can be produced from an equation, in strategy the unknown quantity will overthrow the known elements involved.

In modern war, every great combat is either the result of pre-arranged plans of the highest commander, or the outcome of independent action taken by the commanders of subordinate parts of the army. However this might have been is of no consequence; the important point is that every such combat will effect a decided change in the strategical situation.

This change, therefore, must be considered, either by fully pressing home the victory or by reducing and averting a defeat at the hands of the enemy.

Hence, all the developments resulting from the tactical changes create new situations with which the commander must cope. And this state of affairs will continue till the end of the war. It is as Field Marshal von Moltke has often said: "A system of remedying."

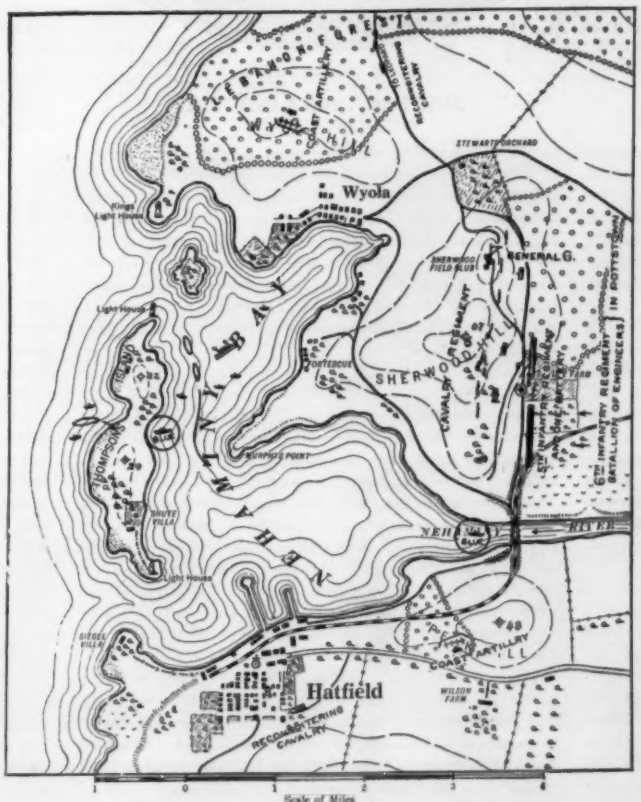


Outline of the administrative service of a field army of three divisions

Ammunition Service:
C. T. Combat train.
D. S. Distributing Station.
A. Ammunition Company.
A. C. Ammunition Column.
R. P. Refilling Point.

Sanitary Service:
A. S. Aid Station.
D. S. Dressing Station.
A. C. Ambulance Company.
F. H. Field Hospital.
H. T. Hospital Train.
E. H. Evacuation Hospital.

Telegraph and Signal Service:
A. H. Q. Army Headquarters.
D. H. Division Headquarters.
Black lines for Sanitary Service. Light broken lines, Ammunition Supply Service. Heavy broken lines, Telegraph and Signal Service.



Answer to question 4 of War Game XI

Hence, all the developments resulting from the tactical changes create new situations with which the commander must cope. And this state of affairs will continue till the end of the war. It is as Field Marshal von Moltke has often said: "A system of remedying."

There is one exception to the above statements, but an exception which strengthens the rule. This is in a case where the original intentions are directed toward evading a vital issue; where the aim of the general staff is to remain on the defensive, to never run the risk of a decisive combat, and to fight with the intention of establishing a balance before their own forces are ready to enter the offensive and decisive.

Considering the lack of preparedness, this sort of strategy would be of great importance as far as our own country is concerned. That such plans can be made successfully and can be realized was shown in the 1914 and 1915 campaign of Germany and Austria-Hungary against the tremendously overwhelming forces of Russia.

Quite naturally, this means of securing victory is a costly undertaking. It might demand the yielding of much territory, and the enemy will occupy this land and derive all kinds of material benefits from it. Nevertheless, where there are no other means, strategy is not particular.

It will now be clear that the possibility of making such plan rests on the fundamental fact that decisive engagements are left out of consideration.

The most important question to decide upon in a war plan is: whether it shall be an aggressive campaign or one of defensive nature. In the first case the main consideration must be the direction of the attack; in the second, how far the giving way should go and when should the counter-action begin.

Beside purely military questions, very often the political situation must be considered. To meet this situation and to bring the two into harmony demands the highest understanding and a deep insight into prevailing circumstances.

In a democratic country, where the peaceful citizens abhor conscription and compulsory military service, an invasion by any enemy would call forth the greatest patriotism and the citizens would rally around the flag. With the full realization of the common danger, the spirit of patriotism would be aroused. This, of course, must be taken into consideration when forming the so-called War Plan.

The offensive war plan has to consider two main questions, and select the one which will promise the greater result. These questions are whether the aim of the campaign shall be the absolute destruction of the enemy forces or whether the occupation of the enemy's territory as a pawn for the securing of peace should be considered.

A good example of the latter action can be found in the Russo-Japanese war. For the Japanese army, it was beyond question to force a final decision against the whole Russian army, therefore the next best thing was the occupation of Southern Manchuria.

With this general information concerning real issues, we may now return to the War Game and see certain strategical and tactical details hitherto not considered.

Considerations in Planning a War Game

First of all, the aim should be to make the War Game as close an imitation of the real war as is possible. This means that every detail which must be considered in actual warfare should also be considered in the War Game. If the War Game handles only small detachments and small encounters, there is much more chance to go into particulars and learn more than from a superficially directed large undertaking. Therefore, detachments of the

(Concluded on page 604)

The Heavens in June, 1916

New Method of Determining the Distance of a Star

By Prof. Henry Norris Russell, Ph.D.

A VERY remarkable piece of work from Mount Wilson deserves the first place in the column this month—namely, a spectroscopic method of determining the distances of the stars.

The very idea of such a thing would have seemed absurd not many years ago—that, from the mere study of the character of the light sent out by a star, it might be possible to find out how far away the star is. But the thing becomes reasonable when it is realized that the details of the spectrum of a star may depend upon its *real* brightness, and that, by comparing this with the *apparent* brightness which it presents to the eye, the distance of the star may be found.

It has been known for nearly 50 years that, when the light of a star is passed through a prism, and collected by a telescope, the resulting spectrum is crossed by dark lines, which, as in the case of the sun, reveal the existence in the star's atmosphere of various gases and vapors, each of which absorbs certain definite kinds of light, leaving tell-tale dark lines to reveal its identity; and also that, though the spectra of different stars were unlike, they might be divided into a relatively small member of classes, each containing hundreds of stars whose spectra were almost exactly similar to one another, while other stars formed links connecting one of these classes with the next by almost imperceptible gradations.

These principal classes of stellar spectra (which are now commonly known by the letters B, A, F, G, K, M assigned in the Harvard classification), bear definite relations to the real brightness of the stars. It is found that all the stars whose spectra are of the kind called B (showing lines of helium, as do the stars in the belt of Orion) are of very great real brightness, fifty or a hundred times as bright as the sun, or more. The stars of spectrum A (like Sirius) are also of high luminosity, though not so bright on the average as the last-named. Among the yellower and redder stars, whose spectra are denoted by the letters G, K and M, it is found that some are very bright, and others faint. In every group can be found some stars as much as a hundred times as bright as the sun, but the faintest stars of Class G (resembling the solar spectrum) are not more than one quarter as bright as the sun, and some of those of Class M are less than 1-100 as bright as the central body of our own system.

From a mere glance at the spectrum, then, if we find it to be of the B or A type, we know that we are dealing with a star of great real brightness, and that, if it looks faint to our eyes, it must in reality be very remote. But if the spectrum should be of Class K, for example, some of whose members are actually very bright and some very faint, we would be at a loss to say whether a star which looked faint to our vision did so because it was really of small luminosity, though relatively near us, or because, although really far brighter than the sun, it was so far away that it appeared to us as a faint point of light.

The recent work of Prof. Adams at Mount Wilson just fills this gap. With the great telescope there, photographs have been made of the spectra of hundreds of stars, some known to be our nearer neighbors, and bodies of relatively feeble luminosity, others remote, and of very great real brightness. The various spectra were then classified and compared. An untrained observer, examining the photographs, would be unable to see any difference between the spectrum of two stars of the same general spectral class, one of high and the other of low luminosity; but when a careful study was made, it was found that there were a few lines in the spectrum which were distinctly stronger, compared with the general run, in the spectra of the former class, and weaker in the latter case, while a few other lines showed an opposite behavior. Upon comparing the estimated intensity of these lines with the real brightness of the stars, it was found that the connection was remarkably close. All the stars in which these characteristic lines were of the same intensity, compared with their neighbors, turned out to be of very much the same real brightness, and the changes in the intensities of the lines, for stars of different real brightness, could be represented, when plotted, by smooth curves.

Having found this to be the case, the procedure was reversed. For a number of additional stars, the intensities of the spectral lines were estimated, the corresponding real brightness read from the curves already prepared, and the distance computed at which the star would have to lie in order that, if of this real brightness, it might appear of the brightness actually observed. The resulting "computed parallaxes" were then compared with the actually observed parallaxes of the stars, and showed an extraordinary agreement.

More than 80 stars have so far been investigated, and it is found that the new spectroscopic method makes it possible to estimate their distances with a probable error of not more than 25 per cent. A range of probable uncertainty of one quarter of the true value may seem large, but these stars are not very near us, and to do better by any direct method of measurement would require a long series of exact observations, which would consume from 20 to 50 times as much labor as the spectroscopic method.

It appears, therefore, that Prof. Adams has presented to the astronomical world a most valuable instrument of investigation, by means of which information regarding the distances of the stars may be accumulated many times faster than had previously seemed possible. So far, the new scheme has been tested out mainly on the stars whose real brightness does not many times exceed that of the sun. If it proves as successful for those which are much more luminous, it will open up a still wider field; and there seems every reason to anticipate that it will.

At 11 o'clock : June 7.
At 10½ o'clock : June 14.
At 10 o'clock : June 22.

At 9 o'clock : July 7.
At 8½ o'clock : July 14.
At 8 o'clock : July 22.

At 9½ o'clock : June 30.

NIGHT SKY: JUNE AND JULY

The Heavens

The finest region of the evening sky is in the south and southeast, where Scorpio and Sagittarius shine among the great star clouds of the Milky Way. The naked-eye observer may note the contrast in color between Antares (α) and the neighboring stars—the former being of the spectral Class M, and extremely red, and the others of Class B, and very white—and the pretty double star μ, which would be easy to separate were it not so low in the sky. Telescopically, the whole of this region of the Milky Way is full of rich fields. One great star cluster north and west of λ Scorpio is especially fine, even in a field glass.

Farther to the left we come upon Aquila, and the two small groups Delphinus and Sagitta, beyond which is Cygnus, with Lyra above it.

Cepheus and Cassiopeia are low in the northeast, Ursa Minor and Draco high in the north, and Ursa Major high on the northwest.

Hercules and Boötes are almost overhead, and Ophiuchus and Lupus are south of them. Virgo, Leo and Corvus are the most prominent constellations in the southwest and west.

The Planets

Mercury is in conjunction with the sun on the 5th, and becomes a morning star. He draws rapidly out to the westward, and reaches his greatest elongation, 22 deg., on the 30th. At this time he rises about 3:30 A.M., and can easily be seen before dawn.

Venus is an evening star, but is rapidly approaching the sun. On the 1st she remains in sight till after 10 P.M., but by the end of the month she sets only 15 minutes later than the sun, and is practically invisible. Telescopically, she shows a conspicuous crescent, which is visible even with a good field-glass.

Mars is an evening star in Leo, setting half an hour after midnight on the 1st, and about an hour earlier on the 30th. He is far fainter than at opposition, but is still a conspicuous object, as bright as Regulus.

Jupiter is a morning star in Aries, rising about 1:30 A.M. Saturn is an evening star in Gemini, easily visible at the month's beginning, but lost in the twilight at its close. On the 22nd Saturn and Venus are within a degree of one another, but both will be too low to be easily seen.

Uranus is a morning star in Capricornus, crossing the meridian at 3:50 A.M. on the 15th. Neptune is in Cancer, observable only just after sunset.

The Moon is in her first quarter at 7 P.M. on the 8th, full at 5 P.M on the 15th, in her last quarter at 8 A.M. on the 22d, and new at 6 A.M on the 30th. She is nearest us on the 16th and farthest off on the 3d, and again on July 1st.

As she completes her circuit of the zodiac, she passes by Mercury and Saturn on the 1st, Venus on the 3d, Neptune on the 4th, Mars on the 7th, Uranus on the 19th, Jupiter on the 24th, Mercury again on the 28th, and Venus on the 30th.

Wolf's Comet

A faint comet, with so definite a nucleus that it almost resembled an asteroid, was discovered by Wolf at Heidelberg on April 27th.

The last observation which has so far come to hand, placed it, on May 10th, in 12 h. 34 m. right ascension, and 3° 24′ north declination, moving about 50 seconds west and 3′ north per day. Though the elements of its orbit will probably very soon be computed, they are not available at the time of writing.

Princeton University Observatory,
May 22nd, 1916.

The Current Supplement

A NOTABLE article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2109, for June 3rd, deals with *The New York Zoological Park*, which, while not covering as much ground as some others, is one of the most notable parks of its kind in the world, both on account of its collections, its splendid accommodations and its unusual natural beauty. The description is accompanied by a map and by a large number of splendid illustrations. Another illustrated article of timely interest is *Airships: Rigid, Semi-Rigid and Non-Rigid*, which describes some of the internal details of the various craft now in use abroad. There is a short account of some new apparatus for *Enlarging and Projecting* photographs by artificial light. There is another installment of the valuable lectures by Sir J. J. Thomson on *Radiations from Atoms and Electrons*, which should be read by everyone who desires to keep up with the latest advances in fundamental science. The final lecture will appear in the next issue. *Science for the Home* tells about the losses and other chemical changes in boiling vegetables, and is a valuable article for the housekeeper and the dietician. *The Development of the Military Aeroplane* is an exhaustive discourse by a recognized authority on aeronautic engineering and is illustrated by diagrams. *Special Steels* discusses these materials with regard to their use in motor vehicles. *The Utilization of Cull Citrus Fruits* tells how great quantities of valuable material may be saved for useful purposes. There is also an unusual number of shorter articles of value.

Inventions New and Interesting

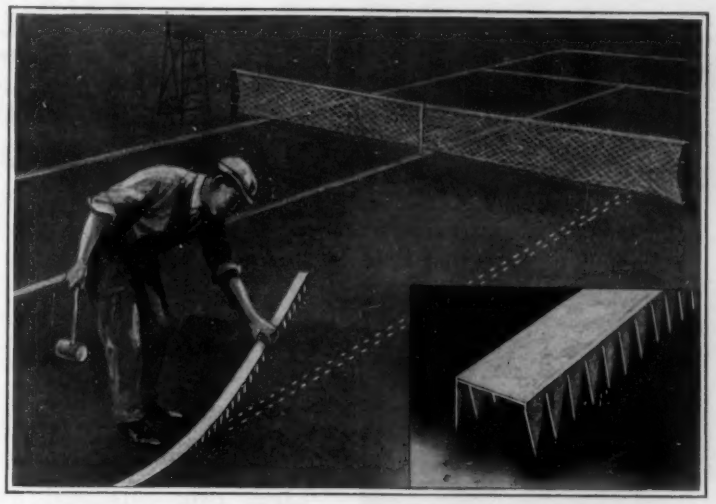
Simple Patent Law; Patent Office News; Notes on Trademarks

A Permanent Tennis Tape Which Is Made Like a Double-blade Saw

THERE has been recently introduced a novel system of marking tennis courts, which appears to have eliminated all the troubles experienced with the use of other methods of marking. For one thing it is permanent, which means that it is always ready for the players.

The new tennis tape is made of galvanized iron cut in sections that are easily handled, and made so as to outline the exact dimensions of the court. As indicated in the illustration the tape is driven into the ground and held in place by the vertical saw-like teeth; and no difficulty is experienced in setting the teeth into the ground, since each tooth is sufficiently flexible to be deflected if it encounters a stone or pebble. The flexibility of the teeth is of prime importance: when the tapes are driven into the ground many of the teeth flare inward or outward, thus clinching the tapes so securely that in play it is impossible to dislodge them, according to the inventor.

The advantages of the galvanized iron tennis tapes over those of canvas are numerous. The former do not shrink when wet nor get loose when dry. Since they are flush with the surface of the court, it is impossible to trip over them. The lines made by the metal tennis tapes are absolutely straight and permanent. In the fall they may be taken up, washed and painted if desired, and relaid the following season. If the teeth of any one section be too much bent, a new section can be substituted at a trifling cost.



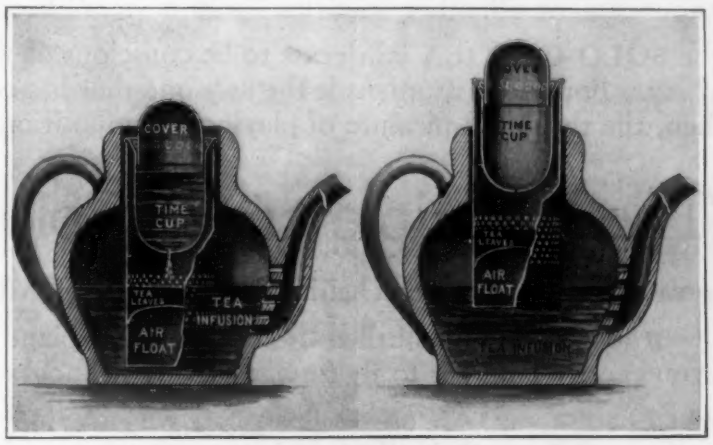
A new method of marking tennis courts, using galvanized iron strips provided with saw-like teeth

A Device that Brews Perfect Tea Automatically

THERE has recently appeared a simple little device known as the "tea bob" for the brewing of perfect tea. The latter expression is used advisedly, for the tea bob produces a beverage that is always of a uniform and proper strength.

As will be noted in the accompanying sectional views of a teapot in which is placed a tea bob, the new device is of simple construction. It consists of several parts, the first of which is the hollow cylinder with perforations about one third up from the bottom. Into the lower end of the cylinder fits an air-tight float, which is removed only to permit of placing the tea leaves in that portion of the cylinder which is perforated. Into the top of the cylinder fits the time cup; and the three parts, all of seamless aluminum, thus joined in one are inserted in the earthenware pot.

As many cups of boiling water as the number of cups of tea desired are poured into the time cup. A certain self-measured quantity of this water is automatically retained in the time cup, while the balance runs through the large holes near the upper edge of the time cup, falling upon the leaves in the holder below. The cover is then placed on the time cup, and no further attention is necessary. In the bottom of the time cup is a mathematically-proportioned hole that allows all the water in the time cup to escape at the instant of perfect infusion. As long as any water remains in the cup, its weight holds the float at the bottom of the pot and keeps the leaves immersed in the fresh boiled water. At the instant of perfect infusion, the water has all escaped from the time cup and the float rises, lifting the tea leaves out of the beverage. The tea can then be served, or if desired it may be served in five, ten or even thirty minutes, as there is no danger of over-steeping since the tea leaves have been removed. The beverage is said to be rich in theine, yet entirely free from tannin, because the brewing of the tea is limited to four minutes; this time limit is regarded by the experts of the London Tea Market to be the standard for obtaining the best results.



Two phases in the operation of the tea bob

Position of the tea bob after the time cup is filled with water, with tea below.

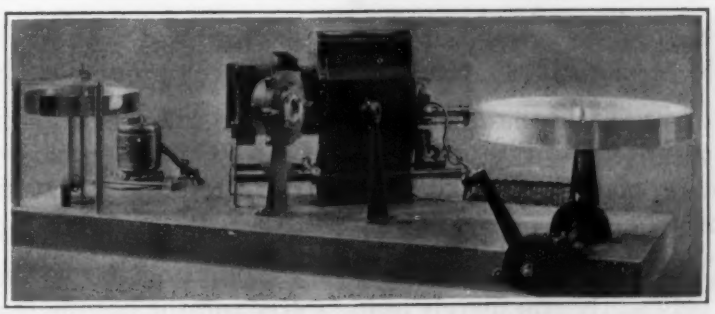
Position of the tea bob after the tea is brewed, with time cup empty.

Making a Motion Picture of a One Hundredth Second Shutter Exposure

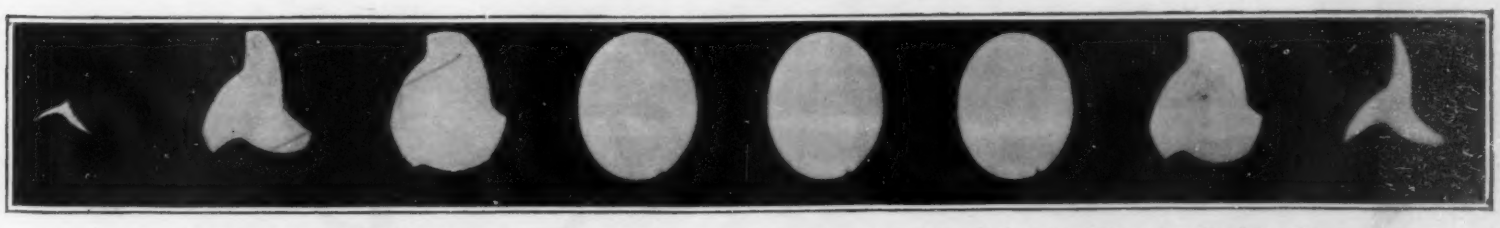
PRODUCING a motion picture film containing 100 pictures of a camera shutter exposure of the order of 1-100th second, each picture showing a distinct location of the shutter leaves at intervals of 1-1000th second and allowed an exposure of but 1-30000th second, appears at first to be a difficult task. Yet an apparatus for just such a purpose has been developed in the research laboratory of a leading American camera manufacturer for the purpose of testing camera shutters.

The shutter testing apparatus is simple, contrary to expectations. It has for its main member an aluminum disk mounted on a vertical shaft driven at 50 revolutions per second constant speed by a specially governed electric motor. Around the edge of the disk are 20 small mirrors. Since there are 20 mirrors and they revolve 50 times in a second, there are 1000 reflecting planes per second which will fall in the path of a horizontal light ray supplied by a small electric arc. The reflected ray is sent through a horizontal tube or barrel in which rests the shutter to be tested. Behind it is placed a lens which focuses on a motion picture film carried on a horizontal reel, inclosed in a box and turned by a handle. As the successive light rays pass through the shutter the instantaneous image of the latter is photographed on the film which, being in motion, advances in time to receive the next exposure further along its length. So it is that during one click of the shutter, which to the lay mind is regarded as an "instantaneous" exposure, the motion picture film has impressed upon it a series of pictures showing the gradual opening, the full opening, and the gradual closing of the shutter leaves—of course, speaking in thousandths of a second. With full knowledge of the timing of the successive pictures on the film, it affords valuable data to shutter designers.

While it is true that the shutter testing apparatus is a novelty, it is not to be considered in the light of a laboratory experiment. Through its use it is possible to study the rate of opening and closing of any shutter and to improve its design and optical efficiency as a result of this study. Aside from studying the speed of a shutter by this means, it is also possible to secure data as to the quantity of light that passes through for any aperture and any time. A shutter designed to open in the smallest possible time and to close in the shortest possible time is the most efficient one, and science is nearer to approaching this perfection than ever with the aid of the new apparatus.



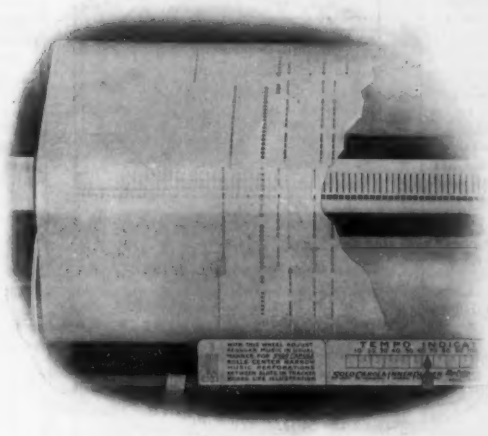
Apparatus for making motion pictures of a camera-shutter exposure, now employed in a camera manufacturer's laboratory



A motion picture film of a 1/100 second exposure of a camera shutter, showing the position of the shutter leaves at various intervals

The first picture shows the leaves just starting to open. In the second picture they are half open, while in the third they are almost entirely open. The next three views show the shutter wide open, and the next three show it closing in successive stages. From these pictures it is learned that the shutter consumed 3/1000 of a second in opening, 3/1000 of a second wide open, and 2/1000 of a second in closing.

Miracle



And now the invention that's most important of all. Notice the long vertical openings in the tracker-board, shown in the accompanying illustration. They are called Solo slots. There is one over each note. Each slot is connected with a small bellows which independently controls the position of each individual piano hammer. You will notice that the roll perforations register exactly with these solo slots before the ordinary striking openings (shown underneath the solo slots) are reached. Thus each piano hammer is automatically set in any desired position before the note is struck. Thus you see, in how simple a manner this player produces an infinite variety of solo effects never before approached on any other player-piano.

Individual Features

The SOLO CAROLA is the *only* player-piano ever made on which you can strike any of the eighty-eight solo or accompaniment notes either independently or simultaneously with varying degrees of power.

The SOLO CAROLA is the *only* player-piano that eliminates completely the mechanical effect in reproducing music.

The SOLO CAROLA is the *only* player so constructed as to be able to play *every* composition ever written for the piano without mutilation or rearrangement just as it was written and just as great artists play it. The SOLO CAROLA will play any standard 88-note player roll made.

The SOLO CAROLA faithfully reproduces the playing of famous pianists with all their individualities of touch, accent, nuance and rhythm.

In *every* respect the SOLO CAROLA is the most wonderful player-piano that has ever been made. We simply can't help being enthusiastic about it—nor can you when you own one.

Musicians Endorse the Solo Carola

Eminent pianists agree that the performance of the SOLO CAROLA is thoroughly musical and supremely artistic.

Some of the most celebrated pianists now living make records for the SOLO CAROLA exclusively because it is the *only* player-piano which reproduces accurately just what they play—just as they play it.

The SOLO CAROLA will astonish and delight you.

With it you may play the softest, dreamiest waltz or the most thunderous crash of martial music in a way heretofore absolutely impossible with a player-piano.

You have only to see, to hear and to play it yourself to be convinced that the *perfect* player-piano has at last been produced.

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Gentlemen: You may send me catalog and complete details of your new *SOLO CAROLA INNER-PLAYER*, together with the name of the warerooms nearest me at which I may personally inspect one.

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Wabash and Jackson
Chicago

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

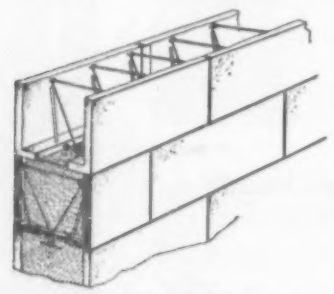
HAT PIN.—MARGARET L. NOXON, 205 W. 102d St., New York, N. Y. This invention provides a hat pin with a pin tongue which is connected with the pin by a spring which is bent back and forth longitudinally of the pin tongue to permit the ready disengagement of the spring from the hair and veil on the head of the woman making use of the hat pin.

EYE SHIELD.—A. N. BAKER 410 4th St., Logansport, Ind. This invention relates particularly to detachable shields designed to coact with the visor of a cap or other headgear. It provides a shield which may be quickly removed or applied to the visor of the cap and when applied may be readily moved to an operative or inoperative position by a pressure on the shield itself.

SUPPORTER.—F. J. SCHNEIDER, 2200 Metropolitan Ave., Middle Village, L. I., N. Y. The improvement refers more particularly to means for increasing the elasticity of the supporter without increasing the effective length of the elastic element thereof, whereby greater freedom in the movement of the limbs is provided for and tearing of the stockings obviated.

Of General Interest

CONCRETE CONSTRUCTION.—R. F. LADIN, 1442 Longfellow Ave., Bronx, New York, N. Y. The invention provides facilities for erecting a wall of any suitable size, thickness or form or for any desired purpose such, for instance, as dams, abutments, building

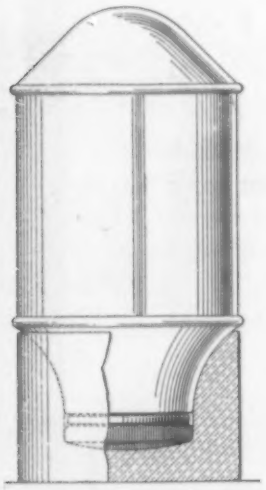


CONCRETE CONSTRUCTION

walls or the like, either vertical or battering, by the employment of means including a plurality of plates, panels or blocks designed to be arranged opposite each other in pairs and suitably connected in space relation and with the space filled with plastic material, said plates or blocks together with the plastic material coöperating and combining to form the structure.

REINFORCEMENT FOR PAPER CORES.—E. L. STUCK, Rothschild, Wis. This invention is an expansible reinforcement and stiffener for the tubular paper cores or bodies on which paper rolls are wound. Such cores are usually made of paper or some like material, and are provided with reinforcements which are riveted in place and hence are not detachable, but permanently associated with the core.

MUCILAGE RECEPTACLE.—C. M. TANENBAUM, 3003 Boardwalk, and C. J. McDaniel, 19 South Connecticut Ave., Atlantic City, N.

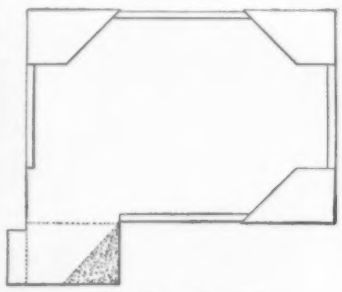


MUCILAGE RECEPTACLE

J. This invention provides a safe and economical device for household and office use at a small cost and known as a "Safety Mucilage Bottle." The advantages secured by the invention are: A brush is not needed; the mucilage will spread evenly; it is always handy and ready for use; there is no waste of material and it will neither harden nor dry out; the contents will not spill when the bottle is upset; it is simple in construction, strong and durable and a saver of time, and in its use the fingers are in no danger of getting sticky.

NON-REFILLABLE BOTTLE.—C. S. COHN, 151 N. 18th St., Portland, Ore. This improvement has reference to bottles having means to prevent the refilling thereof, and more particularly it relates to novel valve means designed to automatically effect a closure of the bottle in any attempt to refill the same with the bottle in different angular positions.

BOOK COVER PROTECTOR.—G. PORTUNE, 4424 Franklin Ave., Norwood, Ohio. This invention relates to book protectors for the backs and covers of books, and one of the principal



BOOK COVER PROTECTOR

objects of the invention is to provide a simple protector of fabric or tape of strong paper, and in different sizes, said protector having pockets at the corners for receiving the corners of the cover of the book, thus providing a protector which is easily connected to the book, and which will extend entirely over the back and cover of the book.

Household Utilities

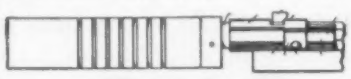
DETACHABLE HANDLE FOR COOKING UTENSILS.—T. C. PHELPS, Address Gustave Disch, 523 Broadway, New York, N. Y. The primary object of this invention is the provision of a simple and efficient form of handle or bail adapted to be detachably connected to any suitable type of frying pan, stewing kettle or the like, the manner of connecting the handle to the vessel providing for the maximum stability and rigidity.

IRONING BOARD.—J. POLL and R. POLL, care of Rainger, Wilhartz, Louer and Concannon, Fort Dearborn Bank Bldg., Chicago, Ill. This improvement relates to the ironing of garments, linen, and the like, and the main object thereof is to provide an ironing board the outer end of which is entirely free in order that shirts, skirts, and the like may be arranged thereon without the necessity for raising the board.

CAP FOR MEAT COOKERS.—A. REUBOLD, 1340 Chisholm St., Bronx, N. Y., N. Y. The invention relates particularly to cookers of the character described and claimed in Letters Patent of the United States, No. 1,006,792 issued to Mr. Reubold. Among the objects of the present invention is to improve the cap portion of this structure so as to make it easier to manipulate and more reliable in use than previous devices.

Machines and Mechanical Devices

ATTACHING MEANS FOR A GUN SILENCER.—A. T. PRATHER, Rodeo, New Mex. In this patent the invention has for its object the provision of means for securing a gun silencer to the muzzle of a gun in a manner which will direct all the explosive gases



ATTACHING MEANS FOR A GUN SILENCER

through the silencer, thereby preventing any escape of the gases rearwardly between the fastening means and the barrel of the gun. The accompanying engraving represents a gun silencer attached by the inventor's improved means to the muzzle of the gun.

OVERHEAD SWITCH AND STOP.—W. ROTHE, 114 E. 91st St., New York, N. Y. This invention relates to overhead trackways such as are in use in warehouses, meat markets and similar places. It provides an automatic stop device for use in connection with a switch, said device becoming functional simultaneously with the shifting of the switch to make it impossible for a trolley to accidentally run into an open switch.

AUTOMATIC STOP FOR MOTOR-DRIVEN MACHINES.—S. DE P. CURRY. Address A. B. Curry, P. O. Box, 292, Key West, Fla. The prime object here is to provide a stop for the sewing machine adapted to be mounted so as to be controlled by the rocking movements of the motor and to instantaneously arrest the balance wheel or hand wheel of the sewing machine upon the release of the driving connection with the motor.

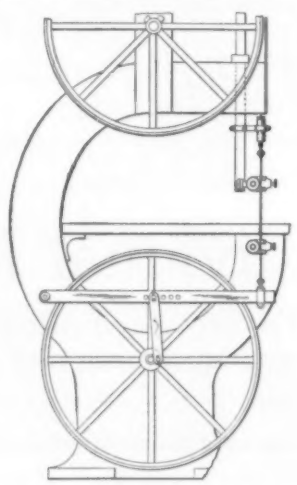
VALVE MECHANISM.—G. P. B. HOYT, 1 Clifton Place, Jamaica, Long Island, New York, N. Y. The mechanism is more especially designed for use on internal combustion engines and arranged to govern the admission of the explosive mixture and the exhaust of the products of combustion, and to prevent leakage of the explosive mixture during the compression and explosive periods, thus rendering the engine highly efficient.

PROTECTOR AND GUIDE.—M. P. WILLIAMS, Box 492, Gilbertville, Mass. The invention provides a protector and guide arranged to prevent adjacent threads becoming entangled in case one breaks, to insure proper twisting of the threads without danger of the threads dropping under the roller or stopping the machine, and to enable the operator to quickly and correctly pass the thread around the roller and into the guide at one operation.

DENTAL APPARATUS.—S. F. KOHN, 190 Brown Place, Brooklyn, New York, N. Y. The invention provides an apparatus with means for furnishing a steady supply of air and gas to sustain a burner flame; provides a unit engine for performing a series of allied functions; and provides an apparatus with a prime mover operatively connected with a series of mechanisms for performing allied and progressively required functions, and with a receptacle for holding tools and accessories to said mechanisms.

TENSION DEVICE FOR WARP BEAMS.—G. KELLER, 164 E. 116th St., New York, N. Y. This improvement provides a tension device for warp beams arranged to permit of conveniently and accurately adjusting the device to any desired degree according to the tension desired on the warp and to enable the operator to quickly throw off the tension on the warp beam whenever it is desired to release the warp for any reason.

CONVERTIBLE SAWING MACHINE.—N. A. SVENSON, 94 Hillside Ave., Wakefield Park, N. Y. This machine can be readily converted from a band saw to a jig saw and vice versa. The invention provides an ordinary band saw with a jig saw attachment and without disturbing the general construction of the band



CONVERTIBLE SAWING MACHINE.

saw. To accomplish the results desired, use is made of a lever connected by a pitman with a crank pin on one of the revolving parts of the band saw, preferably the lower pulley, a saw holder at one end of the lever to which one end of a jig saw blade is attached, and a spring mounted on the guide post of the band saw and connected with the other end of the jig saw blade.

Medical Implements

NEEDLE FOR HYPODERMIC SYRINGES.—H. LAURENT, East Rutherford, N. J. This invention provides a needle shank to prevent the needle shank from breaking off at the needle hub, to cause the fluid in the barrel of the syringe to flow directly into the needle and to allow of readily engaging the butt end of the needle shank with the bore in the outlet of the barrel when placing the hub exteriorly in position on the said outlet.

Prime Movers and Their Accessories

STEAM ENGINE.—A. R. CARTER, 207 E. Thomas St., Hammond, La. This invention is an improvement in the type of multiple-piston steam engines, and the objects are to reduce the cost, weight, and friction of the parts connected with the pistons and crank shaft, as well as to minimize friction and vibration. Mr. Carter has invented another steam engine, such as forms the subject of his allowed application for patent No. 44,563. The present invention is of simpler type, there being but two pistons and the cylinder provided with but three inlet and exhaust ports. It is therefore particularly adapted for light work; and to still further adapt it, he has made it easily convertible from a two-piston to a single-piston engine by means at once simple but effective.

POWER CHAMBER.—J. F. SCOTT, 407 W. 23rd St., New York, N. Y. The invention relates to internal combustion engines and particularly to a power cylinder, and provides a construction which will eliminate the necessity for the use of lubricating oil in the cylinder. It provides a cylinder which utilizes the expansion and contraction of the body thereof for operating a power member, as, for instance, a connecting rod instead of utilizing the conventional piston.

ROTARY EXPLOSIVE ENGINE.—R. E. ZUENDT, 112 Cumberland St., Little Rock, Ark. The invention relates to improvements in rotary explosive engines using a mixture of gasoline and compressed air, and provides a device which will combine the advantages of a rotary engine with those of the ordinary type of reciprocating engines.

Railways and Their Accessories

LOCOMOTIVE DRIVING WHEEL.—M. L. DAVIS, JR., Oak Grove, Ala. This invention relates to a driving mechanism for traction wheels and particularly to a locomotive driving wheel and mechanism, and has for an object the construction and arrangement of an improved driving wheel where the friction is reduced to a minimum.

FEED WATER HEATER.—C. ROCHELLE, 432 East Main St., Washington, N. C. This invention provides a device by means of which the water with which the boiler is charged may be heated prior to its admission to the boiler by heat from the fire box, with means for preventing a disastrous discharge of steam into the cab of the engine from the fire box in the event of the burning out of the water heating parts which are disposed in the fire box.

RAIL ANCHOR.—N. J. SCHELL, Beaver Falls, Pa. The anchor comprises two interlocking rail gripping members adapted to cooperate with a tie to prevent the creeping of the rails, which, owing to the peculiar construction of engaging tongue and groove formed upon the interlocking rail engaging members, will more firmly engage the rail as it tends to creep or slide, but in which the original gripping position of the members upon the rail base will not be changed by such tightening.

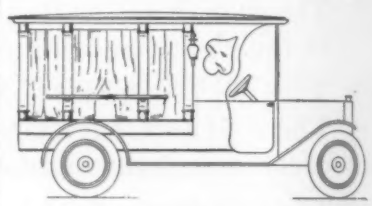
Pertaining to Recreation

TOY SUBMARINE BOAT.—M. W. LEHMAN, 822 Macon St., Brooklyn, New York, N. Y. Among the objects of the invention is to provide a cheap and attractive imitation of a submarine boat, the same being designed to submerge automatically and then subsequently rise to and float upon the surface by a continuation of the same automatic operation.

FISH HOOK.—J. Y. PATTON, Waldron, Ark. The invention relates particularly to improvements in automatic fish hooks. The general objects are to improve the construction and operation of fish hooks of this character so as to be reliable and efficient in use, simple and inexpensive to manufacture, and so designed that the bait-carrying hook will act smoothly and effectively.

Pertaining to Vehicles

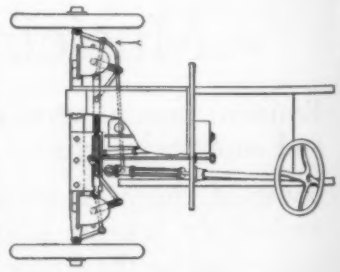
PORTABLE SHELF FOR HEARSES.—R. S. MOORE, 229 E. 75th St., New York, N. Y. This invention provides a collapsible and portable shelf adapted to be carried under the seat



PORTABLE SHELF FOR HEARSES.

of the vehicle, or in any other convenient place, and capable of being quickly attached to a side of the hearse in position to receive the flowers temporarily, while the casket is being handled. After the casket is placed and the flowers disposed of in the usual manner, the shelf is removed from the supporting position and put away for subsequent use.

MOTOR VEHICLE STEERING MECHANISM.—G. W. RICE, Manistique, Mich. Among the principal objects which the invention has in view are: To provide means for manipulating the headlights of a vehicle in correspondence with the steering mechanism of the vehi-



MOTOR VEHICLE STEERING MECHANISM.

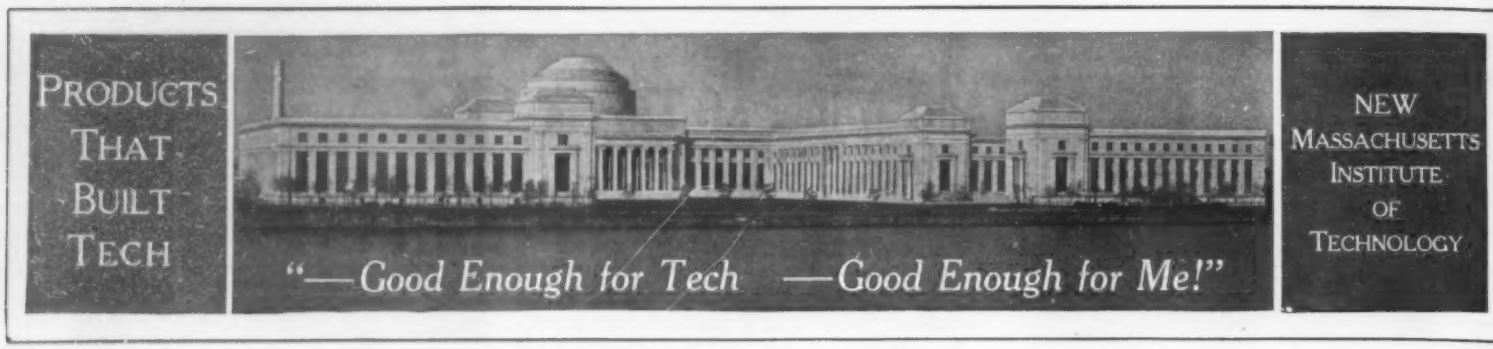
cle, and to provide means for, at will, suspending said manipulation of the headlights. The engraving represents a top plan view of the front fragment of a motor vehicle, showing the steering wheels and mechanism controlling the same, and in conjunction therewith a headlight controlling mechanism.

Designs

DESIGN FOR A SPOON.—J. A. MULCAHY, Deer Lodge, Mont. The ornamental design shows a birthday spoon set with a birth-month stone. The setting is at the end of the handle of the gracefully designed spoon.

DESIGN FOR AN ARTICLE OF MANUFACTURE.—W. E. HUNTER, care of Economy Tumbler Co., Morgantown, W. Va. In this design for an article of manufacture there is represented a goblet on which is delineated a cartouche comprising a combination of fleur-de-lis, foliated border, bells, pendant, floral features, vase, rosette, etc.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



Products that Built the New Massachusetts Institute of Technology

"Good Enough for Tech—Good Enough for Me!"
A PROMINENT MANUFACTURER

WORLD-FAMOUS MASSACHUSETTS INSTITUTE OF TECHNOLOGY will be moved shortly from Boston to a magnificent new $10,000,000 home in Cambridge which has been under construction for more than two years. The dedication will be held with impressive ceremonies on June 12th, 13th, 14th.

The New Technology must stand for all time as an example of the best available in structure and equipment, and the materials used were singled out after a long series of exhaustive tests which as a whole probably have never been duplicated in a building or engineering operation.

A prominent manufacturer expressed the general sentiment recently in giving instructions to his architect when he said, "What's good enough for Tech is good enough for me." Following are the products that have proven "good enough for Tech" in this great educational plant that stretches with its pavilions, courts and colonnades for a half-mile along the Cambridge Embankment of the Charles River.

Builders

Stone & Webster Corporation — Boston, Mass.

Steel Windows, Roofing, Paint

Trussed Concrete Steel Company — Youngstown, Ohio
110,000 square feet (2 1-2 acres) counter-balanced type of UNITED STEEL SASH with sheradized runs and bronze pulleys. See our "ad" next page.

John C. Finegan Company — 462-472 E. 1st St., So. Boston, Mass.
Roofers. 180,000 square feet (about 4 acres) slag roofing, using Finegan's tarred felt and pitch. Floors waterproofed with Finegan's tarred felt and pitch.

National Lead Company — 111 Broadway, N. Y. City
All the painting and decorating done on the Institute were done with Dutch Boy white lead—35 tons being the amount required.

United States Gutta Percha Paint Co. — Providence, R. I.
110 barrels of RICE'S MILL WHITE ("Barreled Sunlight") for painting three-quarters of a million square feet of concrete and brick surfaces. See our "ad" next page.

Wadsworth Howland & Co., Inc. — 139 Federal St., Boston, Mass.
BAY STATE BRICK AND CEMENT COATING used on 200,000 square feet of walls and ceilings in chemistry laboratories.

Elevators

Otis Elevator Company — Offices in All Principal Cities of the World
All "Tech" elevators are Otis. To date, five electric elevators have been installed—one passenger, switch control; three freight, hand rope control; one freight, push button control.

Boilers, Meters, Piping, Ventilating, Pipe Covering, Valves, Plumbing

The Babcock & Wilcox Co. — 85 Liberty St., New York, N. Y.
Three 520 and one 273 h. p. Babcock & Wilcox water tube boilers and steam superheaters, supplying steam for all purposes throughout group.

The Foxboro Co. — Foxboro, Mass., U. S. A.
Indicating and Recording Gauges for Steam, Air and Water Pressure and Vacuum on Condenser. Recording Thermometers for Feed Water, Saturated Steam and Flue Gas Temperatures. See our "ad" next page.

Ehret Magnesia Manufacturing Company — Valley Forge, Pa.
NIGHTINGALE & CHILDS CO., BOSTON, MASS., CONTRACTORS.
The more than twenty miles of pipe and other heated surfaces installed throughout the building, were insulated with "Ehret's" 85% Magnesia Sectional and Plastic Coverings.

The Chapman Valve Manufacturing Co. — Indian Orchard, Mass.
Valves of all sizes up to 12 inches diameter for heating system. Also valves for the plumbing system. Total between 3,000 and 4,000 valves.

Boilers, Meters, Piping, Ventilating, Pipe Covering, Valves, Plumbing, (*continued*)

American Tube Works — 10 Oliver St., Boston, Mass.
Brass piping used throughout the plumbing system.

B. F. Sturtevant Company — Hyde Park, Boston, Mass.
Ventilating system, capacity 800,000 cubic feet of free air per minute. 117 motor driven fans. Also special laboratory ventilation. See our "ad" next page.

Asbestos Protected Metal Co. — First National Bank Bldg., Pittsburgh, Pa.
A. P. M. (Asbestos Protected Metal) used for outlet ducts for hoods in chemical laboratory, and many tons for pent house coverings on roof of chemistry building. Selected for this severe service because of its resistance to gas, chemical and acid fumes.

Wood Working Machinery

J. A. Fay & Egan Co. — Cincinnati, Ohio
Woodworking Machinery for Shops 33 No. 400-A Motor Heads Lathes.

Generators, Switchboards, Electric Lamps, Lighting Panels, Controllers

Hygrade Lamp Co. — Salem, Mass.
Up to the present time have supplied 2680 HYGRADE Gas-filled and 2905 HYGRADE Tungsten lamps. The total requirements in lamps will be approximately 10,000.

Crouse-Hinds Company — Syracuse, N. Y.
Steel cabinets and lighting panels in main group and in power station.

The Trumbull Electric Mfg. Co. — Plainville, Conn.
Furnished all the lighting panels (71 in all) which were used in this building.

Cutler-Hammer Mfg. Co. — Milwaukee, Wisconsin
117 "C-H" electric controllers for controlling motors in connection with ventilating system.

Hardware

The Yale & Towne Mfg. Co. — 9 East 40th St., New York, N. Y.
All hardware for 1400 interior doorways and 30 exterior doorways designed and manufactured by this company. Also a number of Yale Triplex Blocks for use in the laboratories for general hoisting purposes; and as working models showing the latest advances in chain block construction.

Automatic Scales

Richardson Scale Company — Passaic, N. J.
200 pounds Automatic Coal Scale mounted on a motor driven traveling larry; this outfit weighs all coal consumed by the boilers in the power plant of the Institute.

Agricultural Unpreparedness

By Grosvenor Dawe

WHEN the thought of every reader of the SCIENTIFIC AMERICAN will be directed toward the subject of "Industrial Preparedness for Peace," it may not seem inappropriate to draw attention to our agricultural instability as a definite phase of national unpreparedness.

The census of 1910 contained facts of a disturbing nature as to our agricultural population. It showed that 989 counties of the United States—more than one third of all the counties—in the decade between 1900 and 1910 fell off in their rural population. It must be borne in mind that while one third of the counties were thus declining in rural strength, the nation, nevertheless, gained 16,000,000 in total population, indicating a steady movement of the agricultural population to the cities.

Senator Moses E. Clapp of Minnesota, in a recent letter regarding this subject, said: "I believe the greatest problem to-day that confronts the American people is the trend of our population to the cities. It is the great—probably the greatest—contributing factor in the ruin of nations that have perished."

The same census shows that concurrently with this decline in rural population there has been a rapid increase of rural tenancy. In 1910 there were 2,354,676 farms run by tenants in the United States, or more than one quarter of all the farm area of the nation. The great majority of these tenants were on short leases, and therefore not interested in maintaining land fertility. Increasing tenancy implies an increasing number of people who rent, but do not own; who are nomads, in one place for a while and then gone; whose children know nothing of the associations of the word "Home"; whose possessions have none of the memories attached to them by those who live on their own piece of ground; whose roots do not strike down into the soil.

In the trend of the rural population to the cities, and in the rapid increase of tenancy are two weakening forces, both of which have been growing in momentum and in power. Both of them, unless checked, will hinder industrial preparedness for peace.

Not with any intention of overpraising agriculture as compared with the mechanic arts, but solely because of the national good judgment immediately required in the premises, it is necessary to emphasize here that the open spaces produce all the raw materials, except metal, which go into clothing, from the shoe on the foot to the feathers in the hat. They produce every raw material that goes into food, except salt; they produce every piece of lumber that goes into a house, a wagon, or the wood-pulp on which our newspapers are printed. Far more than 50 per cent of all the goods manufactured in the United States are produced from things that live and grow in the country. Without the country the city cannot live; without the city the country would still live by turning back to the simplicities of pioneer days. Consequently, industrial increase urged forward while agriculture weakness grows would simply accentuate the cost of industrial life; for increasing consumers mean increasing prices, and therefore a higher and higher cost of living.

It is not the increased cost of mere living that is the most alarming result from this tendency. It is that the rural people get into the clash of competition and the strain of city life; in many cases increasing the struggle of city life to the detriment of themselves and others. They turn their backs on the comparative freedom and independence of rural regions, and often become bowed down in a sort of industrial slavery; for without money to be spent for food they cannot live. Many bold jobs that crush out courage and individuality. Hence cities are the homes of soup kitchens, charity organizations, bread lines, and all those features which tend to disrupt and destroy the freedom and the independence of the citizens of a nation. In a recent canvass among the jobless of Chicago 20,000 men under 25 years of age, and chiefly from the farms of the Middle West, were found huddling in squalid places.

Therefore, preparedness for peace means much more than industrial preparedness. The term should be wider, broader. It should be National Preparedness for Peace, and thus take in every phase of activity, from agriculture in the fields and work in the factories up to activities in the realms of commerce.

The rapid industrial development of the last half-century is to blame for conditions which, if they continue, will ruin us as a republic. These are not extreme words. They are words of sober sense. Unless the nation gives earnest and persistent thought to this problem of agricultural depletion and increasing tenancy all other phases of preparedness will become insignificant; for a republic made up of cities and of renters is scarcely worth defending as a home of free men. The very fact that we live crowded together with other people brings us under the rule of law and ordinance to such an extent that in the cities there is but little difference between a democracy here and an autocracy elsewhere, in so far as freedom of action is concerned.

Therefore, at this moment when we are so clearly called upon to consider the future of the United States, we must not be bewildered with the thought of merely planning to push out our commerce into foreign countries where hitherto we have had but a slight hold. For after all is said that can be said about foreign trade, the manufactured exports of the United States prior to the great European war were not more than 5 per cent of the total consumption. It is doubtful, no matter how the war eventuates, whether with all our skill we can continue to send abroad in the immediate future more than 10 per cent of the manufactured goods normally required. Therefore, industrial preparedness for peace implies a certain sort of national introspection; for we have hitherto been our own best market industrially, and the maintenance of ourselves as our own best market depends altogether upon the continuance of a right balance in our parts, balance between country and city; since it is the produce of the country that has always served best and most easily to bring other nations into debt to us. It is such a process of introspection that is best for us at this moment, when we seem to be "led up into an exceeding high mountain," with all the kingdoms of the earth spread before us. These kingdoms contain but little for us, when contrasted with the immense things yet in store for us through balanced development within the limits of our own great area and population.

A phase of the subject calling for earnest thought is that there is more money spent to render more facts of usefulness available for farmers than for all subjects affecting either business or labor. In 1914 the agricultural and mechanical colleges subsisting on land grants, together with Farmers' Institutes, etc., owned property valued at $160,000,000; and their total income from all sources, together with the cost of Federal and State Agricultural Experiment Stations, was $40,000,000.

In large measure supplementing this, though of course including appropriations for meat inspection, comes the Federal Department of Agriculture. In 1907 its appropriation was $9,930,440; in 1915 it had risen to $19,865,832. Then every state has some part of its governmental machinery directed towards agricultural betterment, certain of these departments working powerfully and under large appropriations, and some working feebly. Add to all such Federal and state activities certain great private benefactions that originated the Farm Demonstration Work, and now are partly paying for County Farm Advisers; then add contributions from commercial bodies convinced of the agricultural basis of city growth; then add the various railroad systems, with their agricultural departments and demonstration trains, and we have something majestic in total, said to exceed $100,000,000 a year. It becomes evident, therefore, that merely pouring out agricultural advice has not stopped the trend of things.

Careful research among the census figures indicates that rapid increases in land values on a seemingly indefensible basis may have something to do with driving men from the land. To make this point clear, there have been brought together for consideration by readers of the SCIENTIFIC AMERICAN certain figures from the great agricultural state of Illinois—the state that has 7 out of the 12 greatest agricultural counties of the nation. In that state there are 102 counties. The census of 1910 showed that 68 of these had declined in rural population. Yet in every one of these 68 counties the prices of land advanced in percentages ranging from 28.3 to 182.4. For these 68 counties the average decrease of population was 6.6 per cent; the average increase in land values was 180.4 per cent.

There is also the question of high interest rates charged the farmer by those who have money to loan. By drawing upon Census Reports and gathering opinions from financial sources, it appears that in 1910 the American farmer was indebted in these amounts:

Farm mortgages on land operated by owners—United States Census figures.	$1,726,000,000
Mortgages on tenant farms, at same rate per acre as above estimates	1,320,000,000
Average amount of current loans to farmers, on account of crops, chattels, etc.	3,000,000,000
	$6,046,000,000

"From all I have been able to gather from the best available sources," said B. F. Yoakum in *World's Work*, "I estimate that an average rate paid by our farmers is 8½ per cent per annum, which is a conservative estimate of the full cost paid on farm money used in the financing and capitalization of the farms of the United States. The annual interest bill, therefore, paid by the farmers is about 510 million dollars."

If the above enormous total of indebtedness is assumed to have increased during the past five years, it is probably not now less than $6,600,000,000. If it were furnished at 5 per cent interest, without bonus or commission, the farmer, after deducting recording fee, could make a net economy of $225,000,000 per year. What this would mean in the form of permanent investment is this: $225,000,000 per year invested in advance at only 3½ per cent interest would amount in 25 years to $9,070,425,000 plus.

Within the limits of this article it is only possible to show an ailment in the body politic; a weakening of the conservative producing class; a danger. The cure of the ailment is not to be hastily prescribed.

A Census of Colors

(*Concluded from page 578*)

of Naphthorubine, Primuline is encountered commercially, also as Polychromine, Thiochromogen, Aureoline, and Sulphine. Malachite Green, a favorite color, is found under thirty-eight different designations, some representing very slight variations in the exact chemical composition.

The reduction of this extensive vocabulary down to the limited list of nearly 1,000 well-defined dyes has required highly specialized editing. The arrangement, and the full use of synonyms are such as to render the "census," when published, of the greatest utility, not only to all engaged in the manufacture of artificial dyestuffs and especially in planning for the establishment of a comprehensive American color industry—but also to all

dealers in the wares, and to all consumers of dyeing materials.

All three of these categories have hitherto been indebted to the painstaking labors of several prominent German color chemists, notably of Gustav Schultz and Paul Julius, for complete and detailed classifications of the coal-tar dyes in current use. The carefully elaborated "Farbstofftabellen," devised by the two authors, reached a fifth edition in 1914. These "tables," divided into groups according to chemical relationship, give for every artificial dye the commercial designation, the scientific name, the chemical formula, physical and chemical properties, methods of application, tests, and full references to patents and literature. They have for years been the *vade mecum* of all connected with the manufacture of colors, their commerce and their manifold uses.

It has remained for a Bureau of our Government to supplement the work of the German duo, by adding the all important factor of quantity. The complete exposition of the exact amounts of the many synthetic dyes, required to meet the almost numberless needs of a population of over one hundred million portrays approximately the relative demands of all other nations with highly organized textile and allied interests. The young American dyestuff industry, now in a position to expand rapidly and to embrace in its scope the great majority of the colors in current use, will naturally find in it a sure guide for coördinating the diverse phases of manufacture, establishing the capacity of units, and shaping all plans for harmonious expansion.

More than this, it will be of almost equal value to those seeking to create the national coal-tar industries of Great Britain, France, Russia and Italy. Even the newly organized industry in Japan may profit from its summaries, although in a less pronounced degree, on account of the widely divergent taste for colors between the Orient and the Occident.

Should China plan to manufacture her own coal-tar dyes, but little help could be secured from the new work, in formulating schemes for installing plants. Synthetic indigo constitutes two thirds of the Chinese consumption of artificial colors. It enters to the extent of 14 per cent into the Japanese imports of dyestuffs, and forms but 10 per cent of the American consumption.

One of the first results of the compilation of this census was to show how exceedingly vague an idea of the extent to which synthetic dyes are consumed in the United States prevailed in commercial and manufacturing circles. Those most closely in touch with the branch have estimated hitherto that the annual American consumption of coal-tar colors did not exceed 20,000 tons. As a matter of fact, it is nearly one half again this amount—more exactly 29,000 short tons.

In this Census of Dyestuffs, the country has an additional illustration of the manner in which the Department of Commerce is striving to anticipate the legitimate wants of those seeking to perfect the nation's industrial fabric and to promptly place in their hands the requisite tools.

Utilization of Cherry Waste Products

(*Concluded from page* 573)

shown that the juice because of its high sugar content is capable of being converted into several products of commercial value.

By neutralizing the acidity of the juice with milk of lime and subsequent filtration and evaporation, a sirup with a pleasant, sweet, slightly tart taste is obtained. The yield of sirup obtained is about 20 per cent of the juice.

Subjection of the juice to fermentation with subsequent distillation produces a yield of 4.6 per cent of alcohol (95 per cent by volume).

If the juice is boiled with pectin or other jelling medium and sufficient sugar, an excellent jelly with a rich fruity odor and a very pleasant slightly tart taste is obtained.

A conversion of the total quantity of juice available annually into any of these products would result in the production of about 5,000 gallons of alcohol, 21,000 gallons of sirup or 85,680 gallons of jelly. The value of any of these products is difficult to estimate; the two latter, however, would doubtless be most profitable because of the demand existing for commodities of this character.

The facts presented argue strongly for a rational application of the processes of utilization to the waste pits and juice of cherries, which result so extensively in the packing of this important fruit.

Realizing Industrial Preparedness

(*Concluded from page* 576)

men, and are now engaged in inventorying the resources of their respective communities. To assist them in this work, the entire membership of the five societies, some thirty thousand engineers and chemists in all, are serving as Field Aides. Thus an organization of more than thirty thousand engineers has been built up, almost over night, to inventory the resources of the entire country. The State Directors and their Field Aides work under the direction and guidance of the Committee on Industrial Preparedness of the Naval Consulting Board. The greatest possible latitude is given to each State Board in handling its own affairs. In this way, the brains and ability of those very men responsible for development in every line of industry in this country can be most fully utilized. The general scope of the scheme as outlined by the Committee on Industrial Preparedness will be followed by all, and will cover all classes of industries and the principal mines. Detailed methods of carrying out the plan differ somewhat in the different states.

It was thought at first that some thirty thousand large manufacturing establishments would be inventoried. It now looks as if the number would not be far short of eighty thousand, and, in fact, might exceed that figure. The extent to which the smaller establishments were to be covered was left to the discretion of the State Boards who are most familiar with the local conditions in their state. Some State Boards have divided their work into counties and appointed a Chief Field Aide for each county. Others have divided the states into four or five sections and each member of the State Board is responsible for the work in his section. Others, where the local industries of the state are such as permit, have divided the work on the basis of the class of industry. The best method to fit the local condition has been chosen in each case.

All the engineers comprising this great army of trained men work without pay and meet their own expenses. The inventory form was carefully prepared with the aid of the army and navy, the engineers, the manufacturers, and all who might presumably have valuable suggestions to offer. This form does not call for intimate information. However, in spite of the fact that the information is not what is ordinarily considered confidential, all possible precautions have been taken to see that it is held rigidly confidential, and the caliber of the men behind the movement is such that the manufacturer can feel well assured that the information he furnishes will be used as intended exclusively for the benefit of the army and navy. As the completed inventories are received in the office of the Committee on Industrial Preparedness, such items as can be tabulated and summarized are punched on a tabulating card so that all possible significant summaries can be readily made for the entire country by means of mechanical tabulating machines.

The inventory form provides for such data as the physical characteristics of the plant; ground area, floor space, number of stories; whether stories can be added; source of heat, light, water, power; whether the facilities for feeding and housing employees are ample if large addition is made to the force, etc. In general, the information given under the heading of "Plant" shows completely the present physical characteristics of the plant and the possible opportunities for expansion. Under "Manufacturing and Production" such questions as those bear-

ing on the tool equipment idle in slack season, the limits of precision in machine work, the principal materials used and where purchased, and the principal products manufactured, are asked. Each question has been carefully considered and there is a definite reason for it. For instance, if a given concern has a normal yearly slack season, that would probably be the time of the year when it could make the small educational order to the best advantage. The questions are asked as to whether the establishment has ever made army and navy goods for the United States or foreign governments, and whether it has facilities for the construction of jigs and tools. Under the heading of "Labor," the questions cover general labor conditions, the number of skilled men in the shop, the number of unskilled men and the number of tool makers; the number of women in the shop and in what numbers women can replace men if absolutely necessary; and the approximate percentage of employees who are not American citizens.

Under "Transportation," trucking distance, quality of street service en route to shipping point, number of trucks owned and hired, shipping facilities by water, etc., are subjects of interrogation.

Each manufacturer is asked whether he would consider bidding upon regular army and navy contracts in time of peace; whether he would consider accepting army and navy business *in time of war on cost plus reasonable profit basis;* whether he would consider accepting the minimum annual education order, together with payment therefor upon a reasonable basis, and also whether he would favor the enrollment of skilled labor in the "Industrial Reserve." An inventory of "manufacturing and producing equipment" consisting of a summary of classes of tools and types of machinery, is called for. This inventory will assist in the determination of what specific class of army and navy goods, out of the thousands used, a concern can probably best make.

To aid in the work of the engineers and that of this committee, President Wilson has appealed to the business men of the country in an open letter; the Associated Advertising Clubs of the World, in cooperation with the publishers, are placing free of charge full-page advertisements in magazines and newspapers throughout the country announcing this nation-wide, wholly non-partisan, organized movement; national bill-posting interests are placing on the billboards throughout the country graphic posters explaining the work and appealing to the public for coöperation. Neither the advertising men, the artists nor the bill-posting people will accept pay for their labor and the expression of their talent. The moving picture men are doing what they can gratuitously to help educate the public. The newspapers in their news columns and editorials are assisting enthusiastically. In the various states, landlords have given offices free; furniture companies have patriotically loaned furniture; large corporations have assisted in providing clerical help; Mr. Coffin, as Chairman of the Committee, is devoting his entire time to the work of the Naval Consulting Board and his associates in the Hudson Motor Car Company are glad to have him do it. The American Telephone and Telegraph Company has patriotically permitted me to spend my time on the work. The offers of free help and assistance from manufacturers, business men and professional men throughout the country are inspiring. A definite, concrete, important task is being accomplished promptly and efficiently through patriotic motives alone. Can the by-products of such a mobilization of goodwill be over-estimated?

Our New Industries

(*Concluded from page 586*)

for foreign devices. One concern even reports that it has been doing a good business in England, Australia, and South America. The buyers from abroad have been very well satisfied with their dealings with American concerns so far. There is only one thing that the manufacturers are objecting to and that is the high prices that they have to pay for materials. Otherwise the toy makers are satisfied with the most prosperous times they have ever experienced.

In addition to these headliners, many American industries have benefited in smaller degree by the shortage of European supplies. Thus, as a direct result of the difficulty of getting tin from the usual European sources, the American Smelting and Refining Company has erected a smelter at Perth Amboy, N. J., to handle Bolivian tin ore. In the past we depended entirely upon European or Straits Settlements smelters for our supply of tin, amounting to 45,000 tons annually, and never attempted to import the ore and smelt it ourselves. The Perth Amboy plant is designed to handle eventually 15,000 tons a year or about half the Bolivian output. This not only means the establishment of a very important new industry in this country, but will also bring us in much closer touch commercially with some of our Latin-American neighbors. I am glad to say that the Bureau of Foreign and Domestic Commerce was able to assist in the negotiations that led to contracts with the Bolivian miners.

The manganese ore and metal industries have been affected by the shortage of foreign ores, yet the American production has not increased so rapidly as might have been expected. The production for 1915 is thought to have reached 6,000 tons, as compared with 2,635 tons in 1914. Much preparatory work has been done at mines in Virginia, Tennessee, Colorado and California, and a larger production is expected in 1916. The shortage of high-grade ores for use in manufacturing flint glass and dry batteries has been keenly felt. Efforts are being made to conserve during refining the manganese contained in raw pig iron, thereby reducing the amount of ferro-manganese that must be added to make steel.

Invar metal, an alloy of nickel and steel, valuable for instruments of precision because of its low coefficient of expansion, has never hitherto been manufactured commercially in this country, our supplies having come directly or indirectly from France. Of late this has been the cause of considerable delay. The United States Coast and Geodetic Survey is informed that an American manufacturer is now prepared to furnish this material in any quantity desired.

The American imports of ichthyol, an Austrian pharmaceutical product, distilled from fossilized fish remains, which has a very important use in medicine, were of course cut off by the war. In a comparatively short time a St. Louis firm put upon the market a very acceptable substitute.

An American industry with a $1,000,000 market has come into existence as a result of cutting off the imports of petrolatum from Russia. By the end of 1914 at least a score of American refiners were experimenting in the new field and at least ten sources of domestic white oil for medicinal use were soon developed. These new American medicinal oils are quite equal to the Russian product and will probably hold the field permanently.

Bromide papers for photographic use have been largely imported from Germany in the past and the sudden demand for bromine for use in making this paper found the American supply inadequate. Recently the old wells in and about Pomeroy, Ohio, and Mason City, West Virginia, have again been put into active commission. This, in connection with the regular output from Michigan and Pennsylvania, will soon enable American manufacturers of bromides to meet the normal demands of domestic consumption.

The war found us unprepared to manufacture enough lanolin, or refined wool grease, to meet the demand. Ordinarily we import about 12,000,000 pounds of crude wool grease and 2,500,000 pounds of lanolin. The domestic production of crude grease is about 6,000,000, but very little lanolin has ever been made at home. We have always used up the crude grease in tanneries, cordage factories, etc., and left to others the work of preparing the refined wool fat so valuable in salves, ointments, and emulsions. Now the chem-

ical works that once merely dabbled in lanolin are taking up the work seriously.

Previous to the war the better grades of filter paper were supplied almost exclusively by Europe. All grades of such paper are now produced at home, including the very best products.

A well-known St. Louis fur concern is already dressing and dyeing 10,000 sealskins in its present building, using a method formerly employed only in England, and is expanding its plant. This is one result of an agitation for an American fur industry that began soon after the war started. The United States is the largest producer of raw sealskins in the world, and it is also the largest consumer of finished seal furs. This would seem to make it natural that it should sell its own sealskins and dress and dye its own furs. It never has, however. We have in the past sent our raw sealskins to London, paid London for dressing and dyeing them, and brought them back, paying duty double and transportation charges. This added 52 per cent to the price of the raw skins. The Department of Commerce took the first step to end this when it held the first sale of raw sealskins ever held in this country. It was a success, and has led to the permanent establishment in America of a new industry. In the last year there have been several successful fur sales in this country, in St. Louis and in New York.

During the last year there has been introduced into this country the chemical-porcelain industry, with the help of the Bureau of Standards. Two years ago there wasn't a manufacturer in this country who believed chemical porcelain could be made from American materials in American factories. Now two establishments here are making the best type of modern chemical porcelain.

In the past much of the clay used in this country in the manufacture of porcelains came from England, that for the manufacture of crucibles and other high refractories from Germany, and that required for any other fine products from France. Experts in the Department of Commerce have pointed out that clays for all these purposes may be obtained in the United States and by slight treatment be made equal and in many cases superior to the material heretofore supplied by Europe. Many of these clays are found in the South, and are beginning to be produced commercially.

Manufacturers who use whiting, an essential constituent for certain ceramic glazes and bodies, generally have imported this material from England. However, a sample of calcium carbonate submitted recently as a by-product by a firm in Baltimore has been found to be an excellent substitute for the English whiting.

Until recently all naphtha and gasoline internal-ignition safety lamps were purchased abroad. Since the war started patents on a number of foreign lamps have expired and there have already been placed on the market several American lamps of this type. With the help of the Bureau of Mines there have also been developed several types of permissible electric lamps which are now on the market in competition with foreign makes. The best glass chimneys for safety lamps have heretofore come from Germany, but as a result of the war the manufacture of such lamps in this country has been improved, and orders for many thousand such chimneys have been placed in this country by English collieries.

A "more sheep and more wool" campaign is one of the newest efforts to expand American industries and it is already bearing fruit. There is no particular reason why we can't raise more wool at home without interfering with other industries and it is thought that a definite reform in this respect has at last been effected.

Novelty buttons have long been imported from abroad, especially from Austria, Germany and France, and several of our largest manufacturers have been giving that line attention recently. Some good buttons have already been placed on the market and more are promised for the near future. Americans manu-

facture great quantities of fresh-water pearl buttons and there is an important industry in ivory-nut buttons, but the fancy articles manufactured of galolith, celluloid, etc., have come from abroad.

A certain kind of glass in Nebraska was formerly shipped to Germany for use in manufacturing quartz glass for test tubes, retorts, etc. These articles were then shipped back to us at high prices. This glass is now being made in this country and will continue to be made here. Similarly there are now at least four factories in this country engaged in the manufacture of optical glass of a kind that was formerly purchased largely in Europe. These factories report that they are making all the glass they need for their own requirements and some in excess, and it is doubtful whether we shall ever again purchase abroad to the extent we formerly did. In fact, Europe formerly supplied us with large quantities of scientific apparatus of all kinds, but since the war started practically all apparatus of this description is being manufactured by American concerns.

Probably no feature of our recent development has been more satisfying than the growth in the shipbuilding industry. Certainly there has never been a time when tonnage was more needed, and American tonnage especially. During the first three months of 1916 American shipyards for the first time in many years took a lead over British yards. For the three months ended March 31, American yards launched 173 merchant vessels of 94,464 gross tons while, according to Lloyd's shipbuilding returns, British yards launched 69 vessels of 80,561 gross tons; and merchant ships now building or under contract in American yards are approximating the British output for the future.

No attempt has been made to recite all the facts available on the subject of the new and expanded industries that have resulted from the war's interference with our accustomed supplies from Europe, but a sufficient number of instances have been mentioned to indicate the range of products that have been affected and the importance of the continued manufacture of such products to the future prosperity of the country. The importance of these facts is not that we have been able to manufacture certain articles that we never made in important quantities before—optical glass, dyestuffs, potash, dolls—but, first, that there were so many lines for which we were dependent on Europe, and, second, that we are now making many of the things we once thought we could not make and will continue to make them after the war is over.

A University to Order

(*Concluded from page* 583)

fices. The use of a flaring nozzle diminishes the velocity of the stream entering the tank, and at the same time is itself a shield against swirls and irregularities of flow in the still water. Most of the pumps are cross connected in such a way that the discharge from any or all of them may be used in the hydraulic experiments requiring water under pressure. For the measurement of large quantities of water there are two open tanks 10 feet in diameter and 10 feet tall, fitted with gage glasses and vernier scales, so that the water level may be read with the utmost accuracy. Experience with smaller tanks leads to the belief that one man can handle no less than 60,000 pounds of water a minute; this in itself shows the large scale of operations in the new laboratory, and one may readily see that the measurements will be free from that common criticism, "that laboratories work with teaspoonfuls."

The new isolated power house, built on the lines of a big central station, is itself virtually a laboratory, equipped with 2,000 horse-power of boilers and four turbine generators and two motor generators. Alternating current at 2,300 volts and direct current at 110 volts and 220 volts is supplied. The power house also supplies steam for all purposes in the main group, and a subway of reinforced concrete, about 7 feet square and 1,000 feet long, carries the steam mains to the build-

ings and laboratories. For the present a 20-inch pipe will supply low-pressure steam for heating and other service purposes; a 10-inch pipe will supply high-pressure to the laboratories, and a 5-inch pipe will return the condensed water. Condensing water for the turbines comes from the Charles River Basin through a concrete main 30 inches in diameter and a quarter of a mile in length, and is returned to the Basin through a similar main.

From these scattered details it is clear that the Institute will open its next academic year with a wonderful physical equipment, representing the last word in the applied science of to-day. Probably never before has an institution of learning been able to boast complete up-to-dateness in all its equipment, covering such extensive fields. The Institute trustees must share with Mr. William Weller Bosworth, the architect, the credit for this achievement.

Our Present and Future Sources of Vegetable Tannins

(*Concluded from page* 581)

the bark were used for these purposes; in 1915, the amount was about 18,000 tons. It is worth from $5 to $6 per cord of 2,240 pounds on board cars at shipping point. The amount used is nothing compared to the amount wasted in utilizing the timber for lumber and ties.

The reason the bark of eastern hemlock has been used so extensively and that of the western species so little is because the tanneries desiring hemlock are in the East. There is still an enormous supply of western hemlock and while its bark is thinner than that of the eastern form, it contains a higher percentage of tannin. Analyses show from 15 to 17 per cent of available tannins as opposed to about 13 per cent for Pennsylvania bark and a little over 10 per cent for bark from Quebec. That the tannin is of good quality is shown by the fact that in at least one Washington tannery producing chiefly skirting leather for saddles, western hemlock bark is used exclusively. The manufacture of hemlock bark extract may solve the difficulty as to freight costs.

The use of sawmill and logging waste as a source of tannin has not progressed very far in this country. Some recent experiments at the University of Washington with bark, slabs, and sawdust of Douglas fir (*Pseudotsuga taxifolia*) and western spruce (*Picea sitchensis*) yielded the following results:

TANNIN CONTENT OF MILL WASTE

	Douglas Fir					W. Spruce	
	Sawmill bark	Sawmill slab	Fresh bark	Cambium layer	Sawdust	Sawmill bark	Sawmill slab
Per cent total solids	14.75	14.92	11.31	21.96	5.78	12.83	11.25
Per cent soluble solids	13.36	13.02	9.36	19.28	4.40	12.30	10.25
Per cent reds.	1.39	1.90	1.95	2.68	1.38	0.53	0.87
Per cent non-tannins	7.02	7.10	6.74	9.36	3.34	6.42	6.79
Per cent tannin	6.34	5.92	2.62	9.92	1.06	5.88	3.69
Per cent moisture	9.06	6.91	14.27	20.59	15.51	15.23	9.15

Several skins tanned in Douglas fir extract are reported to have produced a very desirable leather with a color similar to that obtained from oak tannin. It is believed that fir slabs containing an average of 5 per cent tannin offer a good material for the tannin extract industry. Compared with western hemlock bark at $11.50 per cord, it was found that three cords of Douglas fir slabs yield as much as one cord of hemlock bark, but at less than one half the cost for the bark.

Bark as a by-product of the pulp industry is beginning to be used in a small way. Another source of tanning materials that has attracted chemists for some time is the waste sulphite liquors from pulp mills. This liquor contains a large amount of organic material which, when treated with certain acids and freed of the insoluble lime salts, makes a fair grade of tanning material for use with other tannins. This source offers good opportunities for further investigation and exploitation.

As an instance of the interest leather

manufacturers are beginning to take in the utilization of logging and mill waste, may be cited the investigations which a large shoe-making concern is now conducting in southern New England in an effort to find any wood or bark with fair tannin content which can be bought for less than hemlock bark. This company is looking into the available supply of by-products of the lumbering and manufacturing industries, such as bark, slabs, culls, and low-grade lumber. In this case the success of the undertaking is doubtful owing to the lack of large milling plants in the region and to the fact that the lumbering operations are on a small scale and widely scattered. In other regions it should prove entirely feasible.

The cones and bark of all our pines contain considerable tannin and this source deserves consideration. It has been found in Europe that leather prepared by the aid of pine cones and bark is equal to that made by the ordinary tanning processes. If the bark of our pines is found suitable for tanning purposes an enormous supply will become at once available.

The bark of the basket willows contains sufficient tannin to make these highly desirable for use for certain fine grades of leather. Up to the present willow bark has had no market value in the United States, but this condition promises to change. As soon as the bark can be had in sufficiently large quantity by tannin extract producers, basket willow growers will find an added incentive to the development of their industry. The tannin content of the bark of the willows grown commercially in this country is as follows: Purple willow (*Salix purpurea*), 8.75 per cent; Lemley willow, (*S. pruinosa*), 6.98 per cent; American green willow (*S. amygdalina*), 11.38 per cent.

Tannin is a general term for a whole group of substances having certain characteristics in common, the most important of which is the ability to convert hides into leather. Comparatively little is known about the chemical composition of even the simplest tannins. In many cases each material contains a different variety of tannin, and that from the same plant may be of a different composition, depending upon the part yielding it, as the wood, bark, leaves, roots, fruit, etc. Hence analyses showing the tannin content of a material are only an indication of the value of that material for tanning purposes. In practice it is customary to use various mixtures or blends of tannins depending upon the quality and color of leather desired. Much also depends upon the preliminary treatment of the hides and the details of the processes used in tanning.

Tanning methods are mostly the result of experience and the rule-of-thumb methods largely employed are in part responsible for the slowness with which new materials are introduced and for the poor results which are so often obtained at first with a new product. It is not so much information regarding the chemical composition of tanning materials that is needed as it is better knowledge of their properties and uses. Many tannins in this country may prove of greater value when used in smaller amounts and in mixture with other materials, especially in the production of different grades of leather. Instead of depending so much on importations which may at any time be cut off, attention should be devoted to the utilization of our own materials, thereby stimulating new industries and reducing waste in others.

War Game—XII

(*Concluded from page 587*)

size handled in our problems are preferable.

The War Games have an added interest if they are carried through each stage with exactness and care. Their usefulness, from the standpoint of the participants, will be greater if they understand all the elements which are of decisive character in real war. With this in mind the following principles may be laid before the reader:

1. The plan of a war game is but the start of the game.

2. Its developments involve new situations which demand new plans.

3. The tactical points of importance are the decisive factors for the coming strategical moves.

4. The factors not purely military, but closely connected with the actions of the army, in fact, in many ways depending upon them, should also be considered. These are the ammunition supply, the provision supply and the sanitary services. The theory of mobilization, the railroad and other transportation services on land and water are worthy subjects for the students of the tactical and strategical arts to consider, and there is ample room for their study in the war game.

The gist of the problems we have handled in the War Game series are known under the military term: "Operations." They are tactical tasks designed to give a clear picture of the actions of independent detachments. The only point untouched was the point of Administration.

We shall undertake to draw a general sketch of the same.

Military Administration

The Administrative Service is divided into two main divisions: one is "The Service of the Interior," and the other, "The Service of the Theatre of Operations."

The duties of the first are to supply the army in the field with everything essential to the carrying out of the task entrusted to the commander. Those of the second are to utilize this service and to accomplish the mission assigned, whatever this might be.

It is evident that, to win a decisive victory, or to even attempt an effective campaign against the enemy in these days of large armies, is a very different proposition from the wars of the past century. There was a time when an army simply provisioned itself from the enemy's territory, by living off that country. Such simple yet uncertain methods belong to a dead age. In our days, as in Napoleon's time, soldiers fight on their stomachs—today, the provisions must be taken along, instead of being secured on the ground.

This is a necessity and has taught the strategist to figure for his fighting forces a base, from which to operate.

A base is a point with railway or boat communications, where a great quantity of war material and supplies are concentrated. In the United States army, the division is the unit, which is provided with ammunition, supply, sanitary and engineer trains. Detachments smaller than a division, when operating independently, are provided with similar organizations.

The consequence of the great size of such organization is its limited mobility, as soon as a first-class railroad service is left behind. The farther the division has to operate from a railroad, the more difficult it will become to hold the line of communications. A line of operations behind which a parallel line of railway runs is the ideal, unless direct lines leading to each division can be had.

The accompanying illustration showing the military and Administrative operations of three divisions will give a clear idea of the working of the military machine.

Answers to Questions in War Game XI

Question 1. At 2:40 P.M. General G was in the Sherwood Field Club, from where he observed the naval developments. He will remain, for the time being, inactive.

As we have seen, he has occupied with one regiment of cavalry Sherwood Hill, placed the 5th Regiment of Infantry, as reserve, in readiness behind the Southern slope of the hill. The 1st Battery, which marched out with the cavalry, was placed behind point 67 out of the enemy's sight. The 2nd Battery will remain with the Infantry.

The remaining forces in Pottstown are still in readiness to be moved forward.

The reason for this seeming inactivity is the fact that until the enemy has shown his own designs, the very best thing for the detachment commander to do is to hold his forces together. In this way he

will be able to meet the enemy wherever he may undertake to land.

Question 2. The 2nd Coast Battery, consisting of four 3-inch rapid fire guns, is in position on Peck Hill. This battery remained inactive for the reason that its guns would be helpless against the 12-inch guns of the enemy cruiser.

By not firing, this battery has remained a very serious menace to the transports. As the developments of the War Game have disposed of the enemy cruiser, this battery will be a trump in the hand of the commander.

Question 3. The battery will remain silent until the enemy cruiser is sunk.

Question 4. Fully answered in the accompanying plan.

Question 5. At 6:15 P.M. the field battery located behind point 67 will open fire on the two enemy transports.

Question 6. General G, having fully realized at 5 P.M. that the enemy has decided to land on the southern edge of Murphy's point where the deep water permits a close approach to shore, was ready to put his plans into the form of an order.

Through his field glass he was able to observe that each transport was carrying a regiment of Infantry of four battalions each, a battery and machine gun company. Therefore, he was facing two regiments of which only the first men have reached shore.

The landing of the batteries would prove a considerable task. Hours would have to pass before these batteries would become a serious menace. But an overwhelming artillery force consisting of the cruiser and the four torpedo boats' guns must be taken into consideration.

At this time, the Blue forces have revealed only the Coast Battery on Wyola Hill and these were silenced by the superior fire effect of the cruiser.

It is plain, notwithstanding the fact that the Blue Detachment of General G is superior in land forces, the enemy's artillery overbalances this advantage.

Therefore, General G's decision must be of defensive nature, with the intention of equalizing the artillery situation. This can be done by simply waiting for further developments and if the Blue navy should fail to improve the situation, to retreat out of range of the enemy's gun fire.

His order would be:

"Sherwood Hill, July 17th, 19—, 5 P.M.

"The enemy has succeeded in entering Nehaminy Bay with one cruiser, four torpedo boats and two transports. One enemy transport was torpedoed near Thompson's Island and was beached there and troops landed on island.

"The other transport is landing troops at Murphy's Point.

"We will defend Sherwood Hill.

"The Battalion of Engineers and the 6th Regiment of Infantry will establish a second defensive line on MODENA HILL parallel with the DEANSVILLE-GREENVILLE ROAD.

"Signal service between Modena Hill and Sherwood Field Club to be immediately established.

"The Hatfield Alpine R. R. will remain open for hospital trains. Temporary dressing station at Schulz farm house.

"I shall remain on Sherwood Hill."

The Result of the Operations

As soon as the Red Cruiser was sent to the bottom of Nehaminy Bay the situation for the Blue forces became better balanced, and naturally the preparations which were made to get out of the effective range of the cruiser were all disregarded.

The Blue artillery, in its full complement, will immediately go into action and the other forces will attack the enemy.

The torpedo boats of the enemy, with two 3-inch guns, each, will still be very effective, but even so, the chances are good to overwhelm the land forces. Those on Thompson's island are already hors de combat and with a forceful offensive and the transports disabled or sunk, the landing effort of the Red forces would be defeated.

THE END.

Plain Facts About Kerosene Carburetors

(*Concluded from page 585*)

a similar member for kerosene on the other side. The plan of operation was to start on gasoline and to run on kerosene only when the retort carried in the center of the heating chamber became sufficiently hot to vaporize the kerosene. This retort communicates with the main mixing chamber by means of three pipes. The main air entrance is on one side of the mixing chamber and directly in line with it on the other side, and not shown in the illustration is the outlet to the engine. The retort is heated by passing exhaust gas through the heating chamber around it.

The instrument at Fig. 4 is a double carburetor, also having two float bowls. Each of the float bowls includes a single jet chamber with a separately adjustable needle valve in each jet and a single throttle chamber and valve. One chamber is for gasoline, the other for kerosene, and in practically all respects they are duplicates of each other. Each chamber contains a weighted air valve, to which is attached an adjustable graded fuel regulating needle, so that any displacement of the air valves affects the fuel supply, because the needle is raised out of the jet when the air valve is lifted. The edges of the air valve seat on a ring having angular walls. The spray nozzles do not supply the fuel directly into the mixing chamber but are located in small diameter choke tubes. The throttle chamber has rectangular ports communicating with the gasoline and kerosene mixing chambers. The movement of the throttle slide is partly rotative and it is also capable of some degree of reciprocation, this movement being against the tension of a spring. By moving the throttle sleeve laterally it is possible to connect either mixing chamber with the engine or to run partly on one fuel and partly on another. This device is an English invention.

Mention has been previously made of the desirability of heating the kerosene vapor to insure a proper gasifying influence. Various methods are followed to attain this end. The most common system is undoubtedly that shown at Fig 5-A in which exhaust gas is caused to flow through a chamber surrounding the Venturi tube which acts as a mixing chamber. In this device the air inlet is supposed to be coupled to an air stove attached to the exhaust manifold so that warm air will be inspired. Of course the exhaust gas circulating around the Venturi, heats that member and as the holes in the spray nozzle, through which the fuel is atomized, are located very near to the walls of the Venturi tube, the fuel is heated as it is sprayed out. At the same time it is broken into a fine mist on account of the speed of the air stream passing through the restricted area of the mixing chamber. It is necessary to start an engine equipped with this carburetor with gasoline and when the parts are sufficiently heated a simple two-way valve at the bottom is turned so that communication is possible between the kerosene float chamber and the spray nozzle.

A kerosene carburetor known as the Chambray is shown at Fig. 5-B. The mixing chamber is concentric with the float chamber and is generally similar in the main details to other standard float feed carburetors. The fuel level is regulated by the float so that it lies about one-sixteenth of an inch below the top of the spray nozzle. When the engine is started a primary air supply is drawn into the chamber surrounding the spray nozzle. This passes up through the pipe just above the spray nozzle at high velocity, and of course draws up a supply of liquid vapor with it. The amount of liquid depends upon the position of the needle valve, which in turn is regulated by a cam member that works in conjunction with the air throttle. A valve regulates the primary air supply and maintains a high velocity of the air so that it is thoroughly mixed with the incoming fuel. From this point the mixture goes into a tube which is placed in the exhaust manifold or

which may be carried in a supplementary heating chamber in connection with the exhaust. The gas is heated in this tube prior to entering the mixing chamber. The richness of the gas is regulated by the amount of air admitted through the secondary air inlet. While in the illustration only a short length of tube is shown, in actual practice about 5 feet of tubing is coiled in the exhaust pipe.

The carbureting device shown at C, Fig. 5 not only depends on thoroughly heating up the mixing chamber but also breaks up the fuel into very fine particles by having it flow through a series of passages between the main air cone and the mixing chamber walls. There is a mechanical inter-connection between the throttle valve and a needle regulating the flow of liquid from the float chamber to the fuel passages. The auxiliary air valve is a peculiar cone shape member so shaped as to assist in breaking up the fuel sprays. Two float chambers are provided, one for gasoline for starting and one for the kerosene. A simple control lever operates the valve at the bottom that connects either of the fuel chambers with the fuel passages.

One of the difficulties advanced against all types of kerosene carburetors is that it is practically impossible to start these cold. The instrument shown at Fig. 5-D employs two sources of heat. A heating or resistance coil designed to be operated by starting battery current is put into operation only when the electric starting motor turns the engine over. The upper heating member through which exhaust gas passes is intended to complete vaporization. A feature of the device is a mechanical atomizer in the form of a rotating vane member which is intended to divide the liquid fuel in fine mist. It is stated that by the use of the electric heating coil that the gas is sufficiently heated to start a cold engine on kerosene.

A number of carburetors have been devised for kerosene and other heavy oils in which a part of the fuel is burnt and the resulting incomplete combustion is depended on to vaporize the remainder. The carburetor shown at Fig. 6 is the subject of a recent English patent and was described in the late issue of the *Automobile Engineer*. This is a partial combustion type and its main feature is that a rich mixture from the neighborhood of the spray nozzle is made to pass through a trap chamber in which the incomplete combustion takes place from which it goes to the throttle chamber where it is diluted with auxiliary or extra air. A series of gauze screens which limit the scope of combustion are placed between the trap chamber and both the throttle chamber and spraying nozzle compartment. The air which enters through the primary air inlet travels upward by the spray jet and it must pass through the trap chamber before it can reach the mixing chamber. The fuel passes through a series of gauze screens into the trap chamber where a spark plug of the conventional pattern starts the combustion when the engine is first cranked over. A spark is deflected from either the magneto or ignition distributor until the rich gas catches fire after which a sufficient heat will be present to maintain combustion in the trap chamber. Above the horizontal screens at the top of the trap chamber is carried the supplementary air inlet. The total air supply from both the primary and auxiliary air inlets is controlled by a weighted valve, which, of course, is under the influence of the engine suction. It is a disadvantage that a certain amount of tarry deposit collects on the gauze screens so these must be arranged so they may be easily removed for cleaning and replaced when clean.

It is also found that a certain amount of the residue due to the incomplete combustion collects at the bottom of the trap chamber and it is desirable for this to be drawn off from time to time or in some cases continuously. One of the patented features is a trap device which consists of a paddle wheel between the blades of which a number of recesses are formed. Only one of the recesses is exposed to the trap chamber at a time and the de-

posit settles in this. By rotating the paddle wheel it is evident that this chamber may be emptied when it registers with the bottom opening and a fresh one brought into position. The rotation of the paddle wheel may be obtained gradually by simple ratchet and pawl mechanism driven from the engine.

This type of carburetor performs well in actual operation, as was attested by a practical demonstration given the writer by a New York inventor of a device of this character. This was fitted to a standard touring car and was easily started by cranking in a customary manner without the use of gasoline. The engine seemed to have the usual flexibility, ran smoothly and "pulled" well. The only objection that could be advanced was a slight haze and odor in the exhaust. No figures were available giving the efficiency of this device, but it was said that a very small percentage of the fuel was consumed in the trap chamber in proportion to that made to do useful work in the engine.

Summing up, it will be evident that the use of kerosene as fuel in automobile engines will not become general until gasoline prices become considerably higher than at present. Kerosene is not used abroad where gasoline sells for twice the average price prevailing in this country, even in normal times. The motorist will have to be educated to tolerate the disadvantage of kerosene carburetors which will only become possible when their advantages are greater than the disagreeable features incidental to their use. For stationary, agricultural and marine purposes, kerosene engines are practical and widely used. The Diesel type, which has not been discussed because it is not a suitable type for automobiles, will utilize all the fuel oils and is very efficient in the foregoing applications.

The Technically Trained Foreman

(*Concluded from page 577*)

visit some place where the processes may be seen in operation. A distinct effort should be made to acquaint the student with the mechanical and technical processes, to impress him with their importance and to get him interested in them, so that he will want to do these things himself, but without allowing the theoretical and scientific side to suffer.

With the increased demand for practical education which would result there would be many schools ready and anxious to take up the work where the high school would leave off. We would find many courses established throughout the country where the aim would be to train young men specifically for the responsible positions in chemical manufacturing plants outside of such positions as would be designated under the head of chemists. By the establishment of such courses, which of necessity would be of shorter duration than the average college course, it would be found that hundreds of young men would be looking for just such opportunities—men who now are excluded, not so much by lack of elementary preparation as by lack of finances and time for the ordinary four-year college course.

That the above conditions exist was felt by the institution with which the writer is connected, and as a result, in 1905 a course was established which has for its aim the training of young men for foremanship positions in chemical industries. A large part of the instruction consists of carrying out manufacturing operations in a series of model plants. On former occasions the writer has gone quite fully into detail regarding these manufacturing plants. It might be mentioned, however, that in these model plants during the past year quite a volume of material has been converted into finished products. It may also be of interest to note that in the first class to take this course only eight came for that purpose, the remainder being taken from men who had applied for other training. For the past three years, however, over one hundred young men have applied annually for the course, of which number only thirty-five can be accommodated.

Of the graduates from this course over

60 per cent are holding positions ranging from foremen to assistant superintendents, superintendents, and even managers of industrial plants. The remaining 40 per cent are employed mostly in laboratories, although a few are acting as salesmen, and a very small number have gone into other lines.

The question of salary is one that is often asked and may be answered as follows:

Starting with the first class of sixteen graduating in 1907 and including the class of fifty-four graduating in 1915, the combined salaries of all these graduates amount to the sum of $345,800 per year; the smallest salary being received at the present time is $680 per year; the largest salary is $11,500. It needs no further elaboration to show that the time devoted to such work has not been spent in vain.

As an outgrowth of this course in Applied Chemistry, one branch of manufacturing, namely, the Tanning Industry, through its organization, the National Association of Tanners, is coöperating with Pratt Institute in giving two courses of training which prepare young men especially for that branch of industry. One of these, the Tanning Course, fits the men for positions of foremen or heads of departments, and is filled almost entirely by promising young men sent from the various tanneries. The other, known as the Applied Leather Chemistry Course, gives young men who have already had a thorough chemical training a better idea of the practical side of the industry, so that they may become more efficient leather chemists.

As a result of what specialized training has done for this particular industry and as an indication of the wide-awake policy pursued, the National Association of Tanners have recently adopted a plan for the establishment of a Research Laboratory to be conducted in conjunction with the now existing tanning courses. This recent development emphasizes very strongly the point which has been raised by others, and corroborates the writer's claim, that when we have properly trained foremen and superintendents, the industries will then receive and appreciate the full benefit to be derived from the knowledge of the research chemist; and in so doing the higher ideals of the universities and the technical schools will be realized.

NEW BOOKS, ETC.

THE AVOIDANCE OF FIRES. By Arland D. Weeks. New York: D. C. Heath & Co., 1916. 16mo.; 128 pp.; illustrated. Price, 60 cents net.

The reduction of waste by fire is no small part of the large question of conservation of resources. Seven states already require the instruction of pupils in the prevention of fires. Some hundred and fifty common causes are tabulated in this text book, many of them indicating inexcusable carelessness. The schools may render a great service to the nation by inculcating the habit of carefulness in children, and Prof. Weeks's little manual presents its information in such a form that it cannot but be interesting to the children and helpful to the teacher.

MECHANICAL TECHNOLOGY. Being a Treatise on the Materials and Preparatory Processes of the Mechanical Industries. By G. F. Charnock, M. Inst. C. E., M. Inst. Mech. E. New York: D. Van Nostrand Company, 1915. 8vo.; 635 pp.; illustrated. Price, $3 net.

This is a valuable contribution, dealing with the application of science to industry. All manufacturing operations are based upon either chemical or mathematical principles, and it is the latter principles that are discussed at great length and with much thoroughness by Prof. Charnock. He brings together in one volume information that would otherwise have to be sought for in scattered treatises addressed to the expert, and he imparts this information in terms that are intelligible to the majority of workers in the mechanical industries. By a careful study of the work, even the beginner may acquire with small time expenditure a fair knowledge of the production and properties of the chief materials of construction, and of preparatory processes, whether the latter depend upon fusibility or upon malleability and ductility. The methods of the rolling mill and the foundry, too often neglected by the young engineer, are here made the subject of close attention and careful explanation. The author's first-hand study of well conducted establishments introduces an element of efficiency that the work might otherwise have lacked.

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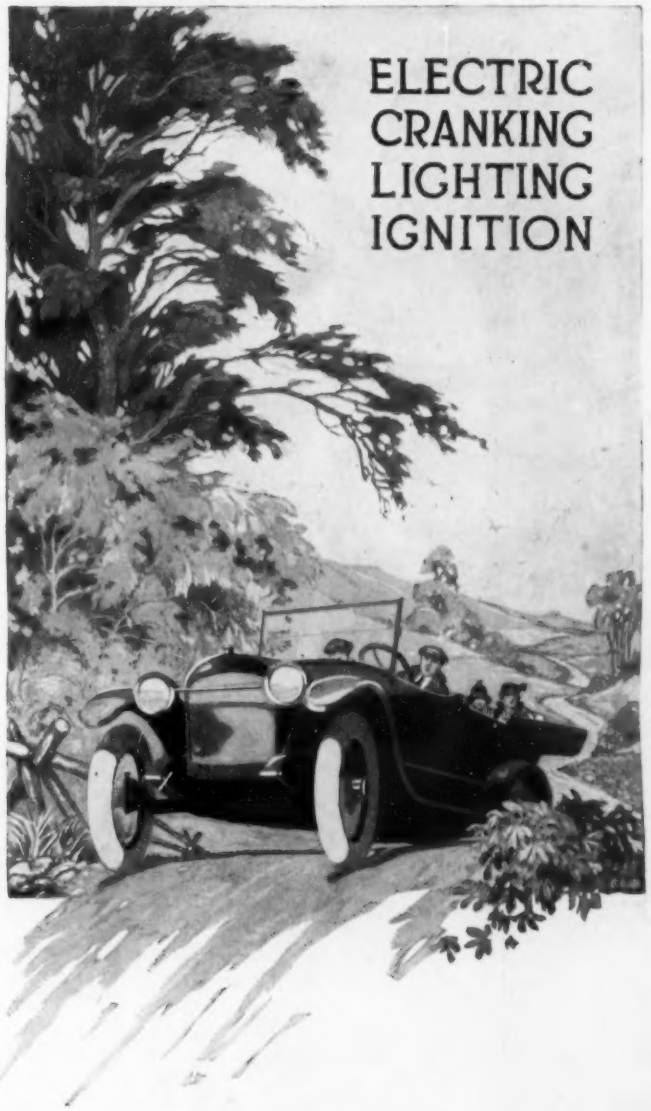

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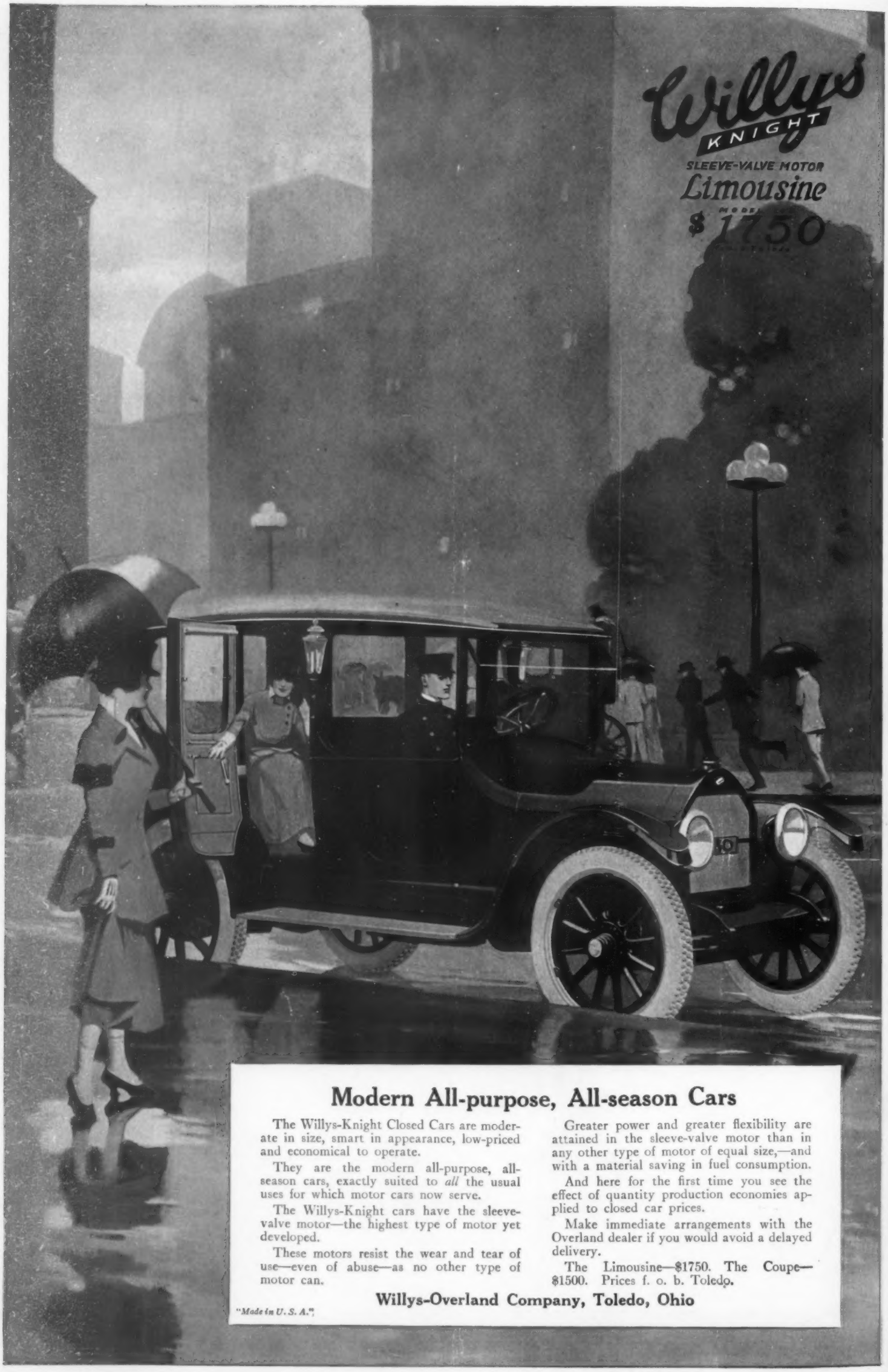

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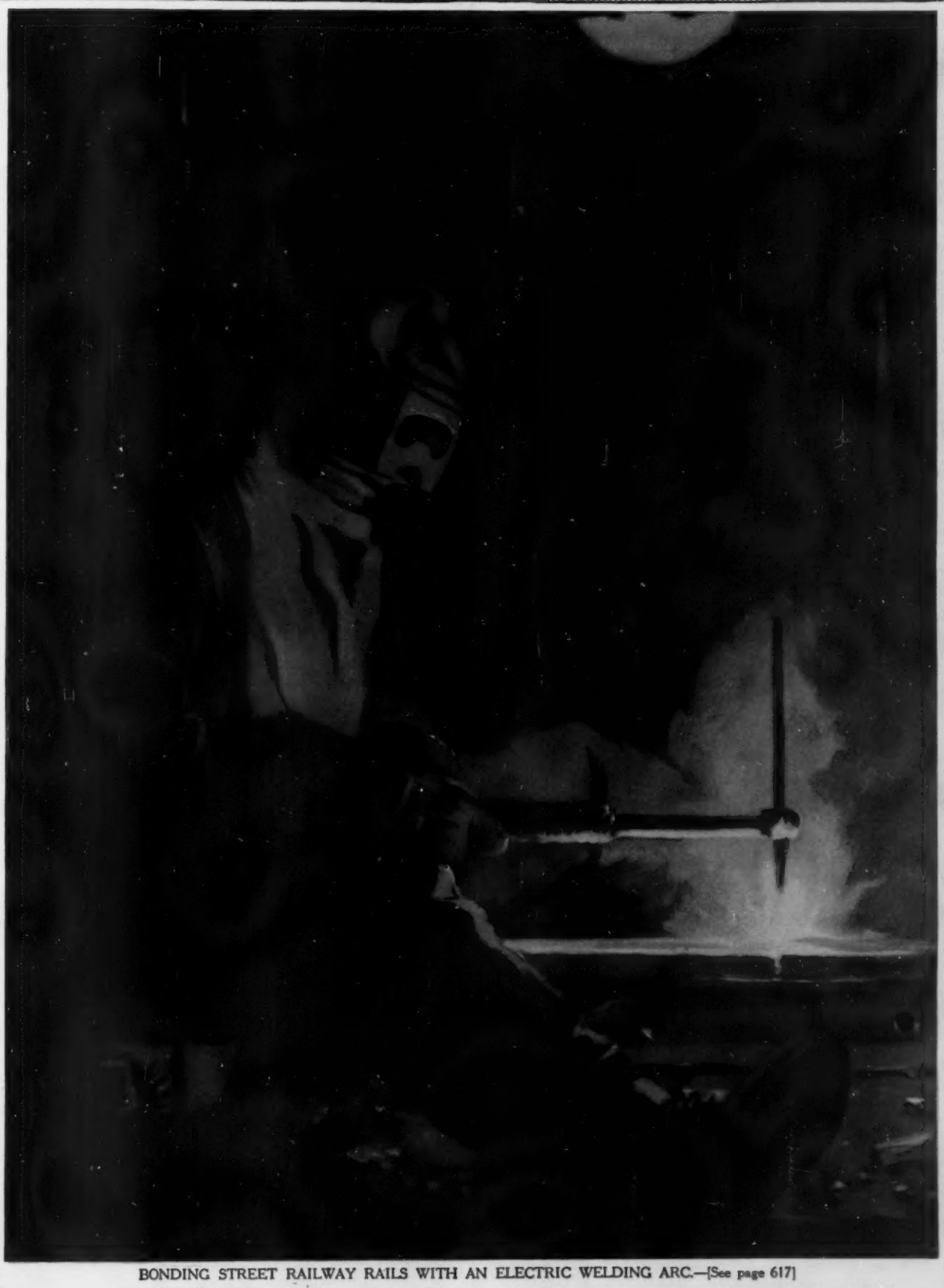

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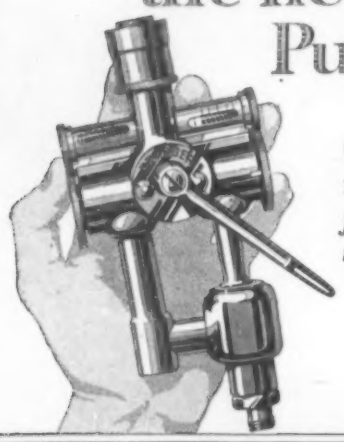

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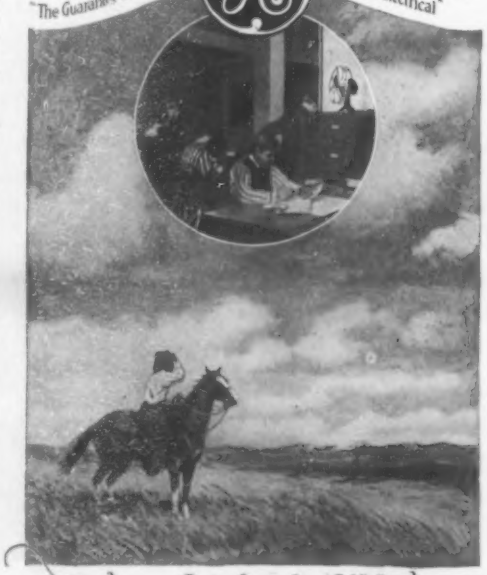

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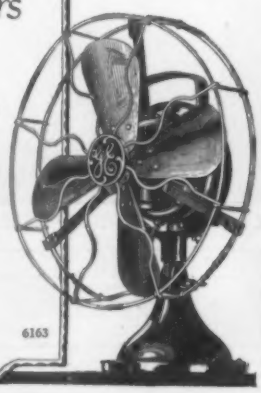

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